The Electrical Industry's Weekly Magazine

October 3, 1960

Electrical World

Price 50 Cents

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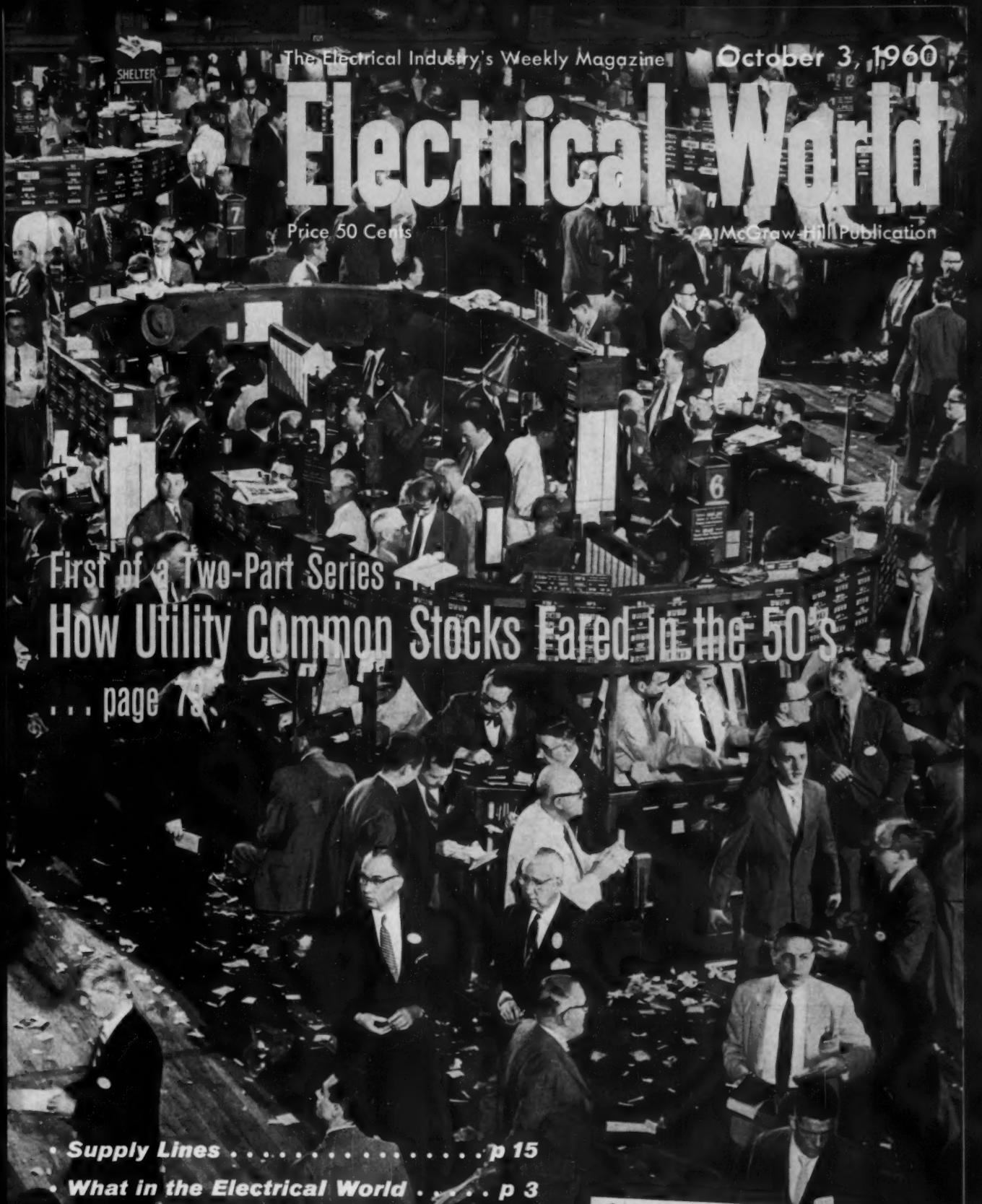

First of a Two-Part Series . . .

How Utility Common Stocks Fared in the 50's

. . . page 78

• Supply Lines . . . . . p 15
• What in the Electrical World . . . . . p 3
• Dateline . . . . . p 5
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UNIV MICROFILMS INC
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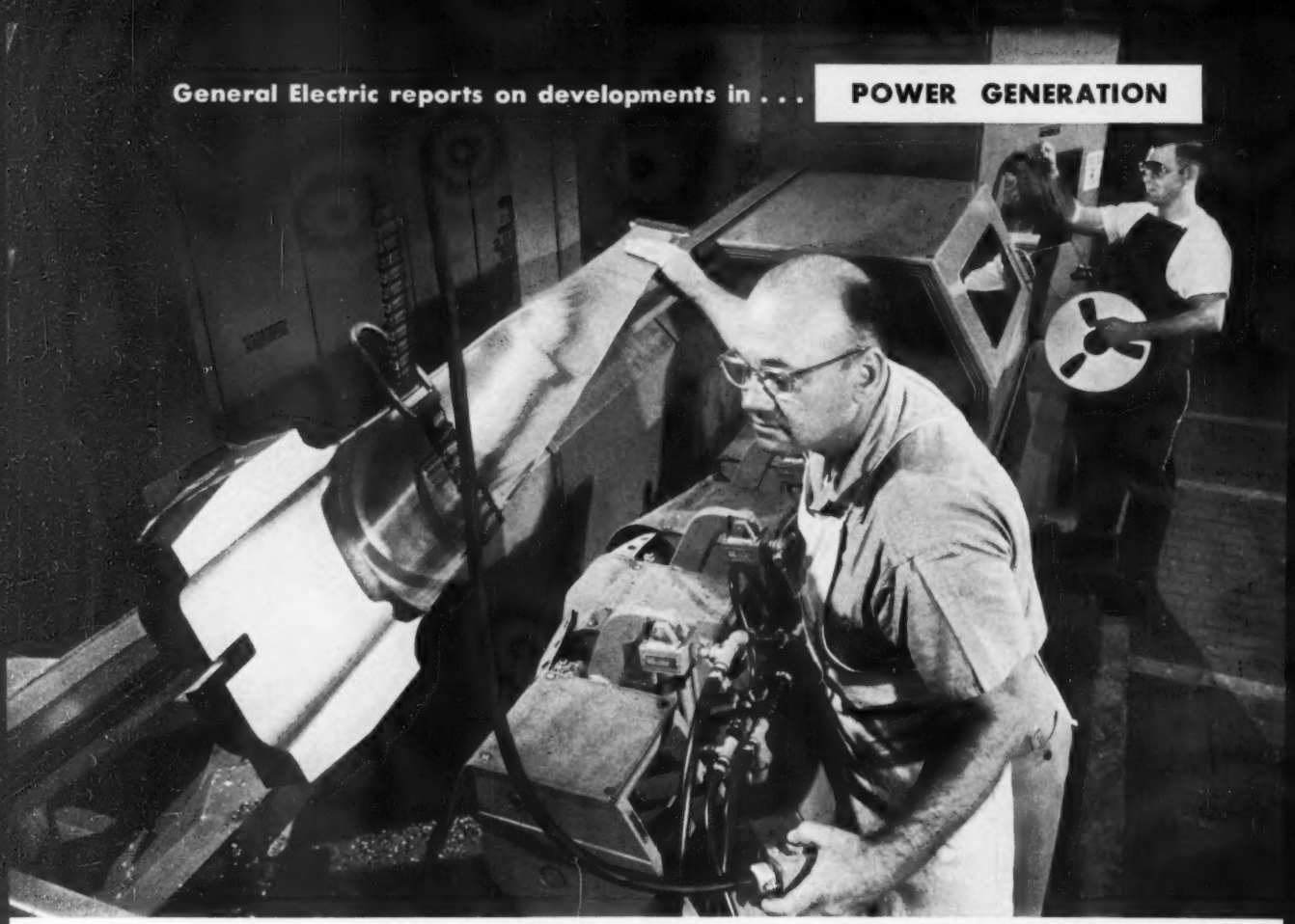
General Electric reports on developments in . . . **POWER GENERATION**



THE MAGNETIC TAPE-CONTROLLED MILLING MACHINE above is being set up for production of the new 50-inch buckets. This is the first application of numerical control for machining complex-shaped steam turbine buckets. This new manufacturing technique will result in stronger, more efficient, more economical buckets.

FIRST 50-INCH TURBINE BUCKET

THIS G-E ENGINEERING TEAM was instrumental in the development of the 50-inch bucket. Left to right, V. S. Musick, J. H. Ouellette, (standing), A. Rubio, J. E. Corr.

GENERAL ELECTRIC is building for 1961 shipment the first 1800-rpm steam turbine with 50-inch last-stage buckets. This latest milestone in turbine design was achieved through the use of new, advanced mathematical design techniques. Extensive laboratory tests were conducted to assure that the new bucket will maintain the high-reliability and long-life qualities of its predecessors.

IMPROVED EFFICIENCY AND HIGHER RATINGS are made possible by the 50-inch bucket. The increased exhaust area permits better utilization of last-stage steam energy and can result in efficiency gains of 1% or more over the present 43-inch last-stage bucket. Higher unit ratings can now be attained without increasing the number or complexity of turbine casings. For example, the ratings of many cross-compound turbine arrangements can be extended as much as 33%.

REDUCED POWER GENERATION COSTS will result from the 50-inch bucket—and from General Electric developments yet to come. By co-ordinating its engineering research, development, and design efforts with those of electric utility engineers, and by making available new and better apparatus for generation, transmission, and distribution, General Electric will continue to help utilities meet America's rapidly increasing demand for low-cost power. 604-06

GENERAL ELECTRIC

Published for 86 years for those engaged in the business of generating, transmitting, distributing, or applying electric power

Electrical World

OCTOBER 3, 1960
Vol. 154, No. 14

Electrical What in the World . . .

Last week, in the inauguration of this column, we introduced format changes in EW. Let's take a closer look at one feature of these changes.

Electrical World had carried the column "Politics & Public Power" for more than a year. By a number of measures, it consistently registered high readership scores. The scores didn't tell us, of course, whether the readers liked it—just that they read it.

In fact, "Politics & Public Power," due to its subject matter and the method of handling, proved quite controversial. Electrical World was—and of course, still is—firmly aligned on the side of the investor-owned utilities in their struggle against the federal government's encroachment into the power business. We have tried to confine our views to the Editorial Comment page, but this did not quiet the controversy surrounding the "Politics & Public Power" column.

Further, we found ourselves using the space for analyzing events not dealing with "politics" or "public power." We began to realize that the column's name was not a good one.

To our surprise, we found that many readers on both sides of the federal power controversy also disliked the title. It was, to quote several, a "catch-phrase" which tended to incite emotion before the first word was read. We have no intention of running away from controversy, but we'd rather it be on a higher level than the mere title of a column.

So when the opportunity presented itself, we changed the title and formally broadened the scope of the column. The result is the "Dateline . . ." news analysis column on page 5.

We hope you'll tell us whether you like the new approach.

Chuck Hochgesang

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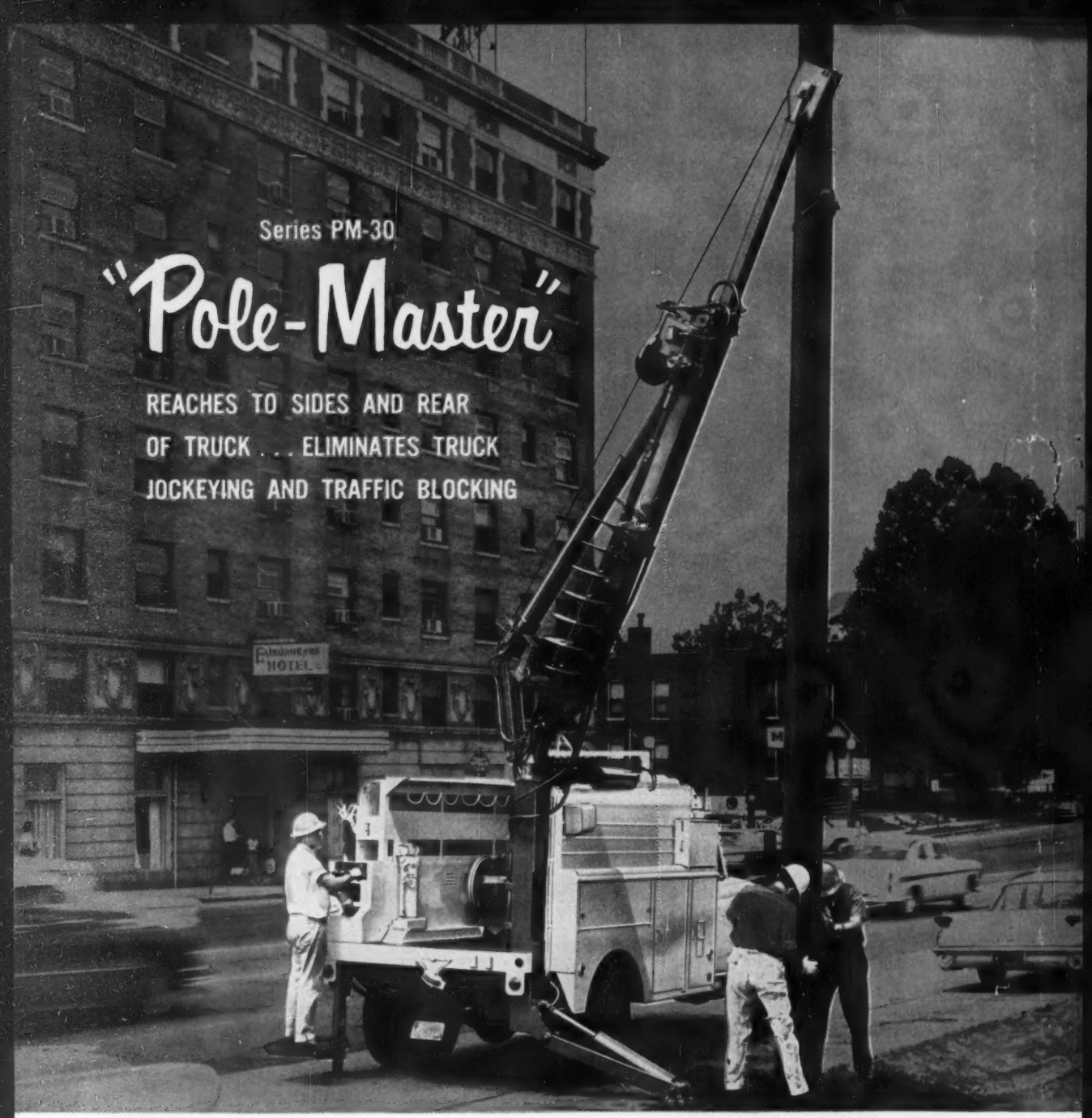

POWERS *American* offers the only corner-mounted oscillating hydraulic derrick available in sizes for handling 40′, 55′ and 70′ pole-setting jobs with fewer men. The PM-30 can be installed on either rear corner on any style body . . . spots anywhere in a horizontal arc extending from one side of body to the other . . . body loads and reaches low for efficient digger operation without auger extension.

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Letters

Thanks From All at Yankee

To the Editor:

We were touched and most appreciative of the generous editorial, "Welcome Yankee! Well Done!" in your Sept. 5 issue.

I think the thing that was most impressive was the way in which Electrical World obviously has got the feel of our approach to this project.

Thanks from all the organization.

William Webster, President
Yankee Atomic Electric Co
Boston 16, Mass.

We Missed Real Point

To the Editor:

I admire that Lapp insulator (EW, Aug. 29, p 76) which your write-up says is over 112 ft long. But you missed the really big news. That makes the man standing beside it about 56 ft tall. When will we hear about him?

Prof A. D. Moore
The University of Michigan
Ann Arbor, Michigan

▶ To Reader Moore and the score of other sharp-eyed EW readers, the insulator was 112 in.—not 112 ft. But don't scale the man down to 56 in.

Add Square Root Sign

To the Editor:

In reading over my article, "Optimum Insulation for Electric Heating Varies With Climate," (EW, Sept. 12, p 94) I noticed that the printer omitted an important square root sign in the equation. This would give quite erroneous answers to anyone who tried to apply the equation. The equation should read:

$$T = \sqrt{\frac{fDk}{142\ M\ (a+b+c)}} - \frac{k}{u}$$

I believe that it would be desirable to print this correction to help forestall some vehement criticisms of the validity of the equation.

C. C. Thomas
Commonwealth Associates, Inc
Jackson, Mich.

Dateline . . .

The Campaign Trail—Swinging around the country, the two presidential candidates were running close to predictions in their pronouncements on power issues. Senator Kennedy was plugging hard for REA co-ops and more federal power projects. Vice President Nixon, though wavering slightly on new starts, was hewing close to established Eisenhower policies.

Speaking to a National Rural Electric Co-operative Assn regional meeting in Hot Springs, Ark., Kennedy declared:

"I have this assurance for the rural families of America, and especially for those men and women who brought electric light and power to rural America with the help of REA:

"1. Under the next Democratic Administration, the administrator of REA will apply no political tests to REA loan applications. He will be directed to approve any loan that meets the traditional standards of merit and feasibility developed under the 25-year-old Rural Electrification Act.

"2. When first enacted, it was clear that Congress intended REA policies to be keyed to economic growth. We must be true to that intention, and work sympathetically with rural electric systems to meet the increasing demands for electricity in rural areas. This means generation and transmission loans when such loans are feasible and will help solve a power shortage or reduce costs.

"3. In place of the government-led campaigns against the rural electrics, there must be a climate of friendly encouragement. The experience and knowledge that rural electrification men and women have accumulated in the last quarter of a century must be used to help us develop the solutions to the rural electrification problems of the future. For this is not the time to stop or hold back. It is a time

(*Continued on page* 39)

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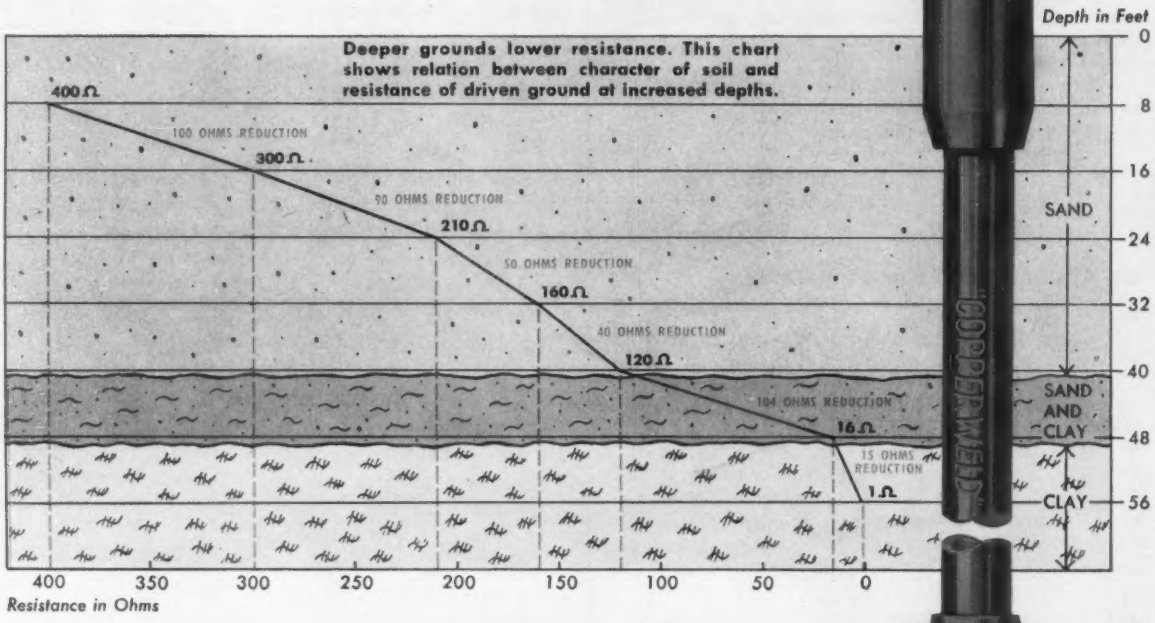

In many areas the surface layer of soil has such high resistance that standard 8- or 10-foot ground rods cannot provide suitable low-resistance ground connections. In such areas, dependable, low-resistance grounds may be obtained by driving sectional ground rods deep into the earth to reach good-conducting soil.

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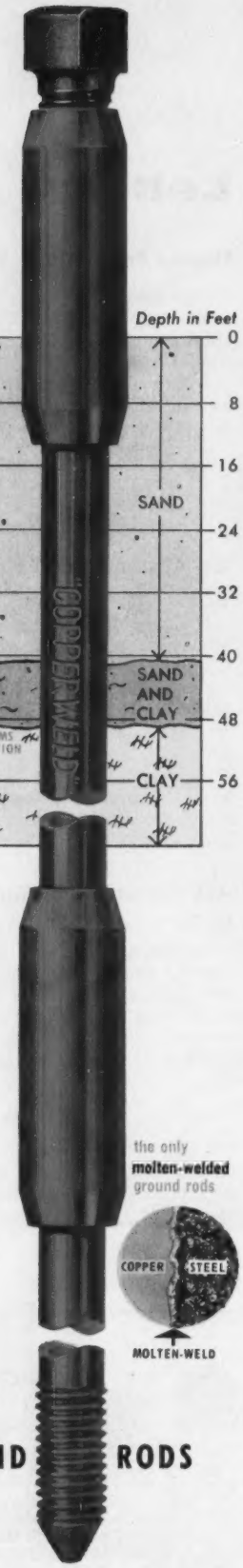

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OWNER-PROVED TORSION-SPRING RIDE! It puts an end to I-beam axle shimmy! Independently suspended front wheels step right over bumps, tough torsion-bar springs soak up jolts. New smoothness speeds up schedules, cuts truck wear and maintenance expense, reduces cargo damage and driver fatigue. Owners report that there's never been anything like it for high-profit hauling!

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ENGINES WITH PROVED EARNING POWER. Famous sixes that out-sell all others because they're best at brightening cost records . . . big V8's that lead the industry for short-stroke design and hard-working durability! Chevy for '61 offers a *long* line of power plants to meet the special needs of every weight class.

The truth is, we could fill every page in this magazine with reasons why Chevrolet trucks have never been better than they are for '61, but there's no need for that. Not when your Chevrolet dealer can boil it all down for you so quickly and pleasantly. See him soon and start saving soon! . . . Chevrolet Division of General Motors, Detroit 2, Michigan.

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New Collins DC system insures uninterrupted communication...when you need it most!

Now... security against even momentary outages during power-disrupting storms. Collins' dc-powered Microwave and Carrier Systems operate directly from float-charged batteries — eliminating rotating machinery. The results: improved reliability, reduced power drain, lower maintenance, decreased noise and elimination of standby generators. Several voltage combinations are available, enabling you to select the one that best integrates with your existing plant. For technical literature, write Collins Radio Company, Texas Division Sales, 1930 Hi-Line Drive, Dallas 7, Texas.

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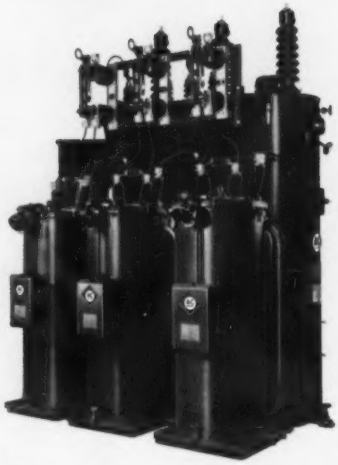

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SAFETY — By-pass switches are fully visible. Permit de-energizing regulators and control without interrupting service.

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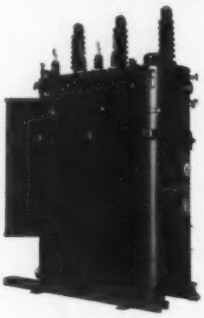
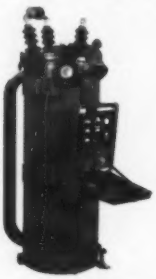


CLEAN, UNCLUTTERED APPEARANCE with sealed-tank construction has no external braces to trap debris, reducing costly cleaning and repainting requirements. Entire line is computer-designed to provide minimum height and weight, quiet operation, ample overload capacity and corona-free performance. All transformer accessories are conveniently grouped to reduce inspection and maintenance time.



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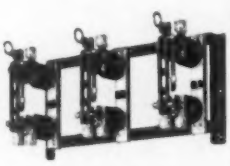

RELIABLE, COMPACT BY-PASS SWITCHES. All operations are performed in complete safety and in proper sequence. Visible break switch opens both leads to the series windings . . . safely interrupts exciting current. Locks securely — no accidental dropping of load.

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Electrical World

OCTOBER 3, 1960

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LATE NEWS ▶ **English Electric and General Electric Co, Ltd** (no connection with GE), will "explore immediately" a merger which could produce $500-million holding company. Both supply utility markets.

Precedent-setting, FPC decision on 12-year Phillips Petroleum case substitutes area or field prices for traditional rate base method for setting natural gas prices.

US and Canadian delegates at Columbia power conference agree on report to be submitted to respective governments. Early approval of treaty, still to be written, might permit projects to start in 1961.

Office of Civil Defense Mobilization will test National Emergency Alarm Repeater (NEAR) system on distribution lines of Consumers Power at Charlotte, Mich., Oct. 11. System sends low frequency tones from substations to alarms in customers homes.

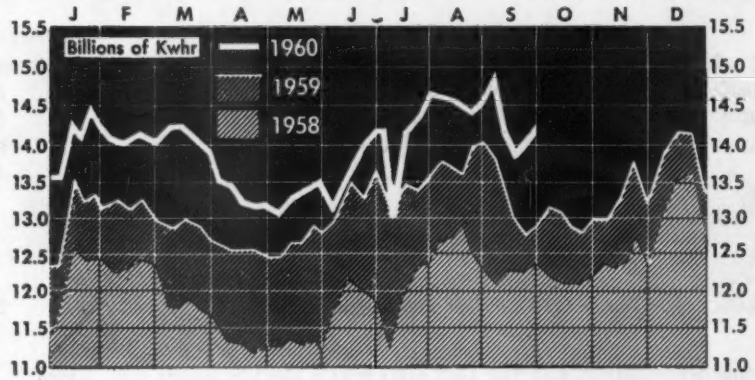
ECAP participants file for rehearing on accounting treatment of ad expenses. Application asks FPC to grant a rehearing and reconsider its order of Aug. 17; vacate the order and dismiss the proceedings, or grant a 120-day stay until after the rehearing or judicial review.

California-Oregon Power gets $1,013,572 increase (9%) from Oregon PUC to make rate of return 5.51%. PUC specifies 25% must come from industrial and commercial customers. COPCO had asked increase be limited to residential customers.

In an unprecedented joint venture, Pennsylvania Electric Co and Warren Electric Co-op apply for FPC permit to study the power potential of Kinzua Dam, being constructed on the Allegheny River by Corps of Engineers. Penelec proposes to build 75-300-Mw pumped storage facility while Warren, acting for 13 Pennsylvania co-ops, would build a 17.5-Mw run-of-river plant and a 75-Mw re-regulating plant. Penelec would operate co-op stations and transmit all power over Penelec lines.

At press time it appeared that the threatened IUE strike against GE would be postponed until Oct. 16. Gov Foster Furcolo of Massachusetts offered to get together with governors of New York, Pennsylvania, Ohio, and Kentucky to see whether a strike could be averted.

WEEKLY POWER OUTPUT—Up 9.9% (Week ending Sept. 24), Kwhr 14,156,000,000



Per Cent Change From Previous Year

	Sept. 10	Sept. 17	Sept. 24
Total U. S.	+ 8.4	+ 8.8	+ 9.9
New Eng.	+ 4.7	+ 1.5	+ 3.3
Mid. Atlan.	+ 0.1	+ 8.0	+ 4.0
Cent. Indust.	+10.4	+ 9.3	+ 6.5
West Cent.	+16.9	+12.3	+ 9.6
Southeast	+ 7.9	+ 5.2	+ 7.6
South Cent.	+15.3	+12.3	+13.1
Rocky Mount.	+ 9.2	+14.2	+15.1
Pacific			
NW	+ 5.2	+ 4.5	+ 8.6
SW	+ 8.9	+15.9	+15.5

Seasonally Adjusted Index 273.5

Week Ago 266.0 Year Ago 245.7

Source: Edison Electric Institute

Supply Lines

VIEWS ON THE BUYERS' MARKET

How long will it last? "It's good for another six months at least," says one thoughtful utility purchasing executive in the northeast referring to the current "buyers' market" in electrical equipment. It could continue beyond that. He bases his forecast generally on the outlook for the economy as a whole. When the upturn comes in the general economy, he would expect to see some changes in the electrical equipment market. Unlike many manufacturers who see overcapacity as the main reason for the current soft prices in equipment, this purchasing man believes they stem mainly from the antitrust cases and the continuing threat of foreign competition.

Manufacturing sales executives take to the road. Purchasing men from such widely scattered points as Montana and Connecticut report that the "buyers' market" is bringing numerous calls from "higher-ups" among their suppliers. "I've been meeting sales vice presidents that I never knew existed," says one long-time purchasing man. "Nothing quite like this has happened in my experience," he continued. "I suppose the recessions of 1954 and 1958 just weren't long enough to bring this kind of activity from the suppliers."

Generally the purchasing men like being courted. For one thing, it is a recognition that a "buyers' market" exists. For another, the appearance of supplier executives at the customers' offices indicate that selling efforts are being stepped up. "I take this as a sign of very hard and very healthy competition," comments one utility purchasing man. After years of dealing with the district representative, or the sales engineer, another PA says these visits "are putting us on our mettle."

MORE PRICE REVISIONS ANNOUNCED

Actual price reductions on lightning arresters were made by General Electric Co effective Sept. 19. These are approximately 1.2% on all station arresters and about 2% on all intermediate arresters. GE accomplished the reduction by changing its multiplier on the station units from 0.79 to 0.78 and on the intermediate units from 0.90 to 0.88.

Published price reductions of 15% on station cubicle switchgear and 20% on isolated phase bus were made by Westinghouse Electric Corp effective Aug. 23. While there was no further explanation by Westinghouse, this appeared to be another move to bring published prices nearer to actual selling prices.

Pricing nomenclature continues to be confusing to many observers of the present equipment market. Even manufacturing representatives are not always able to give the precise meaning of such terms as catalogue prices, list prices, published prices, selling prices, market prices, estimating prices, and book prices. The glib use of such terms may occasionally give the wrong impression—as when the reduction of a book price might actually mean a rise in current selling prices.

NEW MOVES TO DISCOURAGE IDENTICAL BIDDING

Practice of identical bidding brought moves on three fronts in recent weeks:

- In Kennebunkport, Me., the National Association of State Purchasing Officials voted to cooperate with US and state trustbusters on the problem of identical bidding.
- In Knoxville, Tenn., the Tennessee Valley Authority was handed the seven

bids (five of them identical) on a lot of 28,500 transmission suspension insulators. The board is expected to make the award within a week or two.

• In Washington, D. C., the Senate Anti-Monopoly Subcommittee said that it was working on a report to be submitted early next year on identical bidding experienced by TVA and the Defense Department.

In voting to call on the Justice Department to discourage identical bidding, the state purchasing men were accepting an invitation issued to them earlier by Robert A. Bicks, who heads the Justice Department's Antitrust Division. Bicks told the purchasing men that his division kept a close watch on identical bids coming into federal agencies and he offered the services of his department to state agencies which might be suspicious of bids.

The TVA board must decide whether to award its insulator contract to a low domestic bidder, to a foreign supplier, or try again to get a greater variety of bids. The board earlier rejected a set of bids very similar to the ones it now has under consideration. In inviting re-bids, it asked domestic manufacturers to become more competitive in their bidding.

The Senate Anti-Monopoly Subcommittee, headed by Sen Kefauver (D-Tenn.), held two days of hearings in Knoxville last year on identical bids received by TVA. Testimony from the Defense Department this year will also be included in the report to be issued. Grand Jury investigations in Philadelphia this year have overshadowed the subcommittee activities.

DOES THE FEDERAL GOVERNMENT HAVE A PLACE HERE?

Occasional speculation that the government might move in to somehow control or regulate the electrical equipment market comes from several sources. A western utility PA voices the hope that such will never come to pass. The owner of a small equipment manufacturing plant sees the need for some sort of government intervention to help stabilize the current pricing and marketing situation. At no time has such speculation been more than a murmur in the industry.

Takeoff point for such speculation apparently is the demands which the Justice Department has made in its civil suits brought against some 28 electrical manufacturers in connection with alleged antitrust violations. These demands would require that manufacturers found guilty under the civil action issue new price lists based on individual cost figures and individual judgment as to profits. In most cases, manufacturers found guilty would also be required to keep records and prepare statements for customers to show that the court judgments have been carried out.

To interpret these demands as a threat of government control of pricing is a long jump. In the first place, court trials must be held to determine whether defendants are guilty. Second, it will be a court—and not the Justice Department—that determines proper civil judgment in the event that defendants are found guilty. Third, Justice Department attorneys handling these cases have given no indication that they desire to maintain control of electrical equipment pricing—or to do any more than police against antitrust violations. Fourth, the initial demands of the Justice Department were the maximum demands that could be anticipated. Fifth, no one as yet has interpreted the Sherman Antitrust Act as requiring a continuing regulatory or control body, or anything more than an enforcement agency.

Line Material Introduces STYLED MERCURY Luminaires

Line Material's distinctively new 1000 and 700 watt LINE 2E2 mercury luminaires offer superior lighting and elegant daytime appearance. The fresh modern styling complements and enhances the surrounding landscape and architecture.

A powerful, efficient optical system featuring Holophane's latest refractor provides unprecedented lighting quality.

Lustrous aluminum finish and five pastel decorator colors are available to add unique beauty to your lighting installations.

Ask your L-M Field or Lighting Engineer for complete details, or write to Line Material Industries, Milwaukee 1, Wisconsin.

490

FOR HIGH-LEV OUTDOOR LIGHTING

Dynamically ele
Progressively sty
Handsomely mo
Gracefully uniqu

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LINE MATERIAL Industries

McGRAW-EDISON COMPANY

Outdoor Lighting

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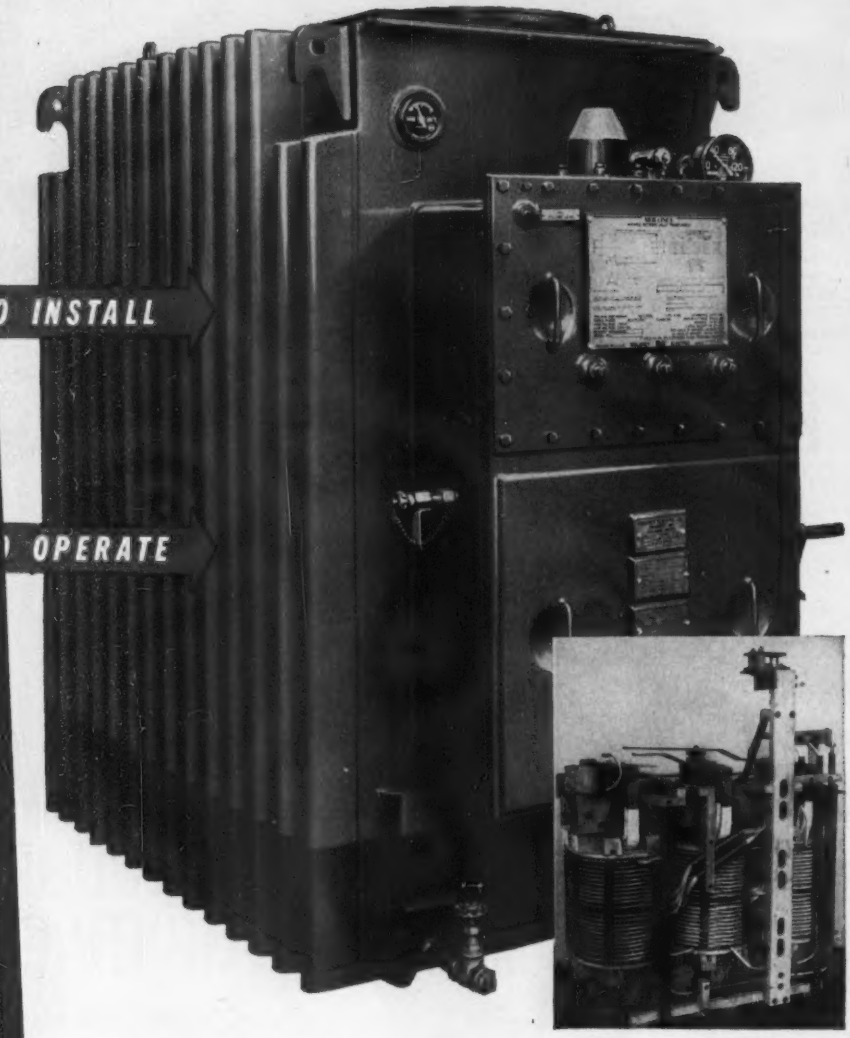
LINE CONSTRUCTION MATERIALS · PORCELAIN INSULATORS · FIBRE PIPE AND CONDUIT

ECONOMICAL



BECAUSE:

1. Each tank side completely corrugated out of one piece of metal, requiring welds only at the corners.
2. No thinning of the metal occurs at corrugations.
3. The corrugations do not need sidewall bracing therefore, another possible source of corrosion is eliminated.
4. Tank is easily cleaned from above and there are no inaccessible areas to hinder painting.
5. The tank and handhole covers are welded in place to eliminate the possibility of leaks, however, bolted covers are available if required.
6. Network transformers with corrugated tanks are smaller in size than old style tube type tanks.
7. Reduced size allows installation of larger units in existing vaults.
8. Protection against corrosion is provided by undercoating the base and the lower portion of the tankwall.
9. The core, coil, leads, supporting members and framework are uniquely combined to give ample electrical clearance and to obtain a rugged unit that is exceptionally compact.
10. Low sound level means better customer relations.

Moloney Network Transformers are uniquely designed both inside and out to provide a superior unit for use on secondary network distribution systems. The corrugated tank coupled with a compact, rugged core and coil assembly having high overload capability, offers the potential user many reasons for purchasing Moloney Network Transformers.

These units are available in types conforming to EEI-NEMA Standards or in types especially designed to meet the requirements of your network system.

Specify Moloney Transformers for every application . . . All Along The Line.

ME55-10

MOLONEY ELECTRIC COMPANY

nsformers for Utilities, Industry and Electronic Applications

ORIES AT ST. LOUIS 20, MO., AND TORONTO, ONT., CANADA

Sales Offices in All Principal Cities

A GIANT STEP FORWARD IN STEAM CONDENSER DESIGN

The size of turbine-generators grows and grows, requiring larger and larger steam condensers. But increasing the size of the condenser shell and adding more tubes is not enough—*the condenser must be designed to make the most efficient use of the cooling surface.*

This is just what C. H. Wheeler's new "Quadruple-Bank" Condenser does. Four tube bundles and 5 steam lanes assure penetration of steam to every square inch of tube surface and minimize pressure losses.

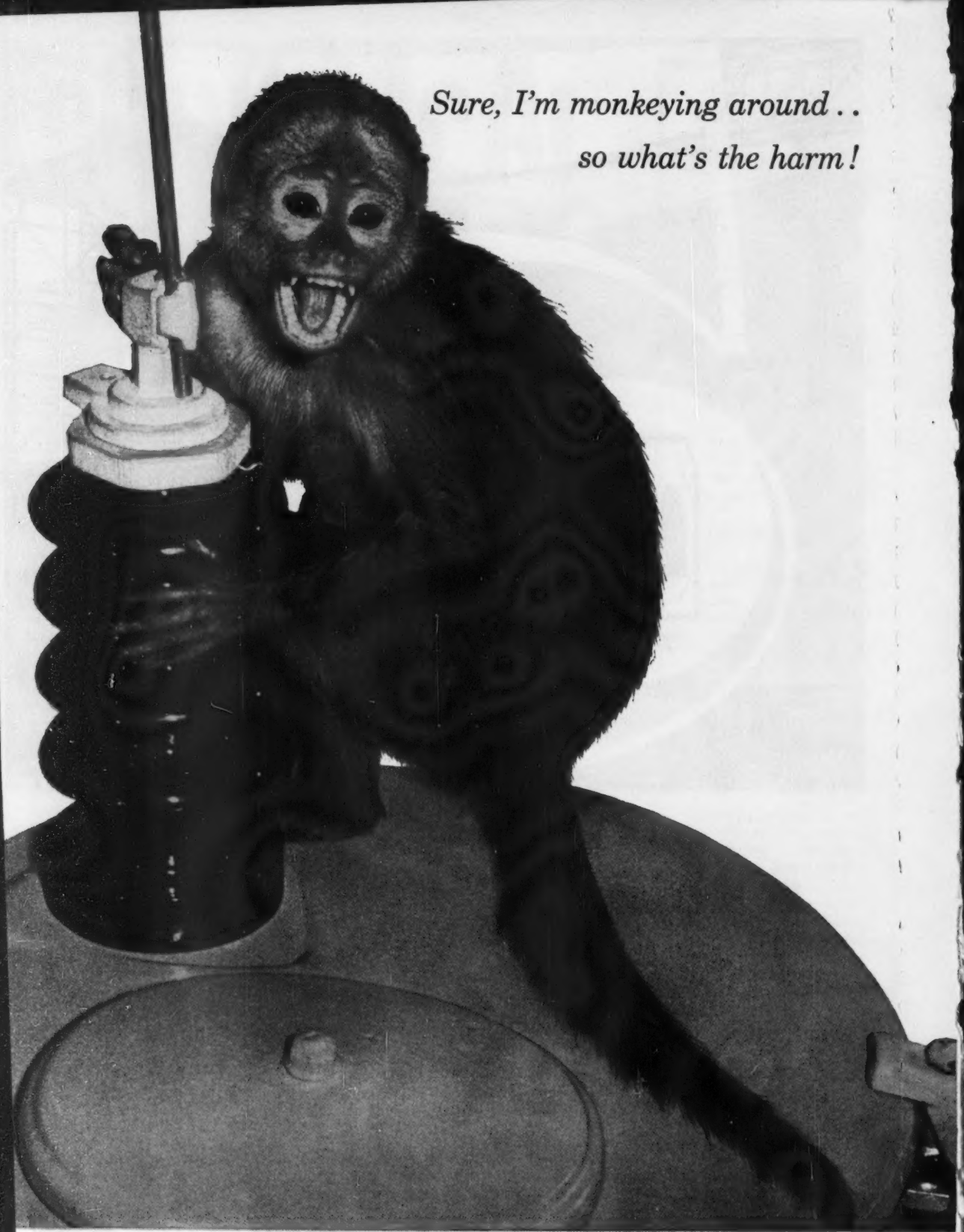
A unique and especially advantageous feature of C. H. Wheeler's "Quadruple-Bank" design is the fact that each tube bundle is provided with its own draft and air cooling section connected to common air removal equipment. This arrangement provides for balanced flow of steam inside the Condenser.

Quadruple-Bank Condensers are available with C. H. Wheeler's special deaerating features, which reduce oxygen content in the condensate to 0.01 cc. per liter, or less. (Our latest deaerating design is expected to produce condensate with an oxygen content of almost zero.)

Consult your local representative, or write our Philadelphia office for more information about condensers and other auxiliary equipment—ejectors, circulating water and condensate pumps, feedwater heaters, evaporators, heat exchangers.

C. H. WHEELER MANUFACTURING CO.

19th and Lehigh Avenue, Philadelphia 32, Pa.



e monkey, photographed by
ylor Beech, Pennsylvania
ansformer staff photographer.

McGRAW EDISON

PENNSYLVANIA TRANSFORMERS

PENNSYLVANIA

New "Sky-blue Covers"

on Pole Star® Distribution Transformers prevent animal-caused outages ... and protect wildlife!

Whether monkeys, parrots, sparrows or squirrels ... members of the wildlife community who pause atop Pole Star Distribution Transformers can now make contact between transformer cover and bushing terminal without harming themselves and *without causing line-to-ground short circuits.*

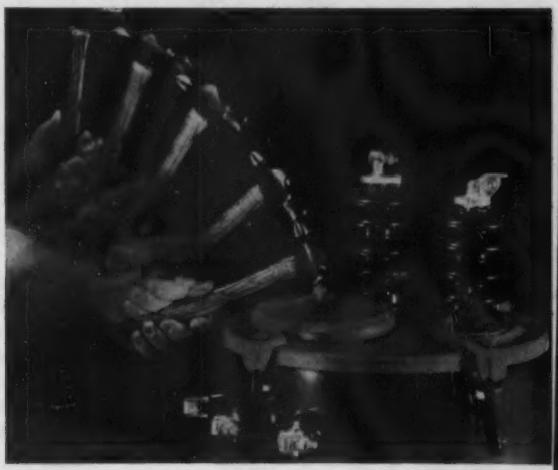
Pole Star's new Sky-blue Covers are the reason. Insulated by means of specially applied polyvinyl-chloride, Sky-blue Covers eliminate the need for bushing caps, terminal taping and other devices for preventing animal-caused outages. Thickness of the insulating finish is varied to provide an *extra margin* of dielectric strength in all voltage classes.

Easy identification of cover-insulated transformers in storage and on poles is made possible by the distinctive color of Pole Star's Sky-blue Covers.

Sky-blue Covers will be standard on all pole-type Pole Star Transformers with cover bushings. For additional information or a quotation on specific requirements, contact Distribution Sales Department, Pennsylvania Transformer Division, McGraw-Edison Company, Canonsburg, Pennsylvania.

No external bushing clamps on new Sky-blue Covers

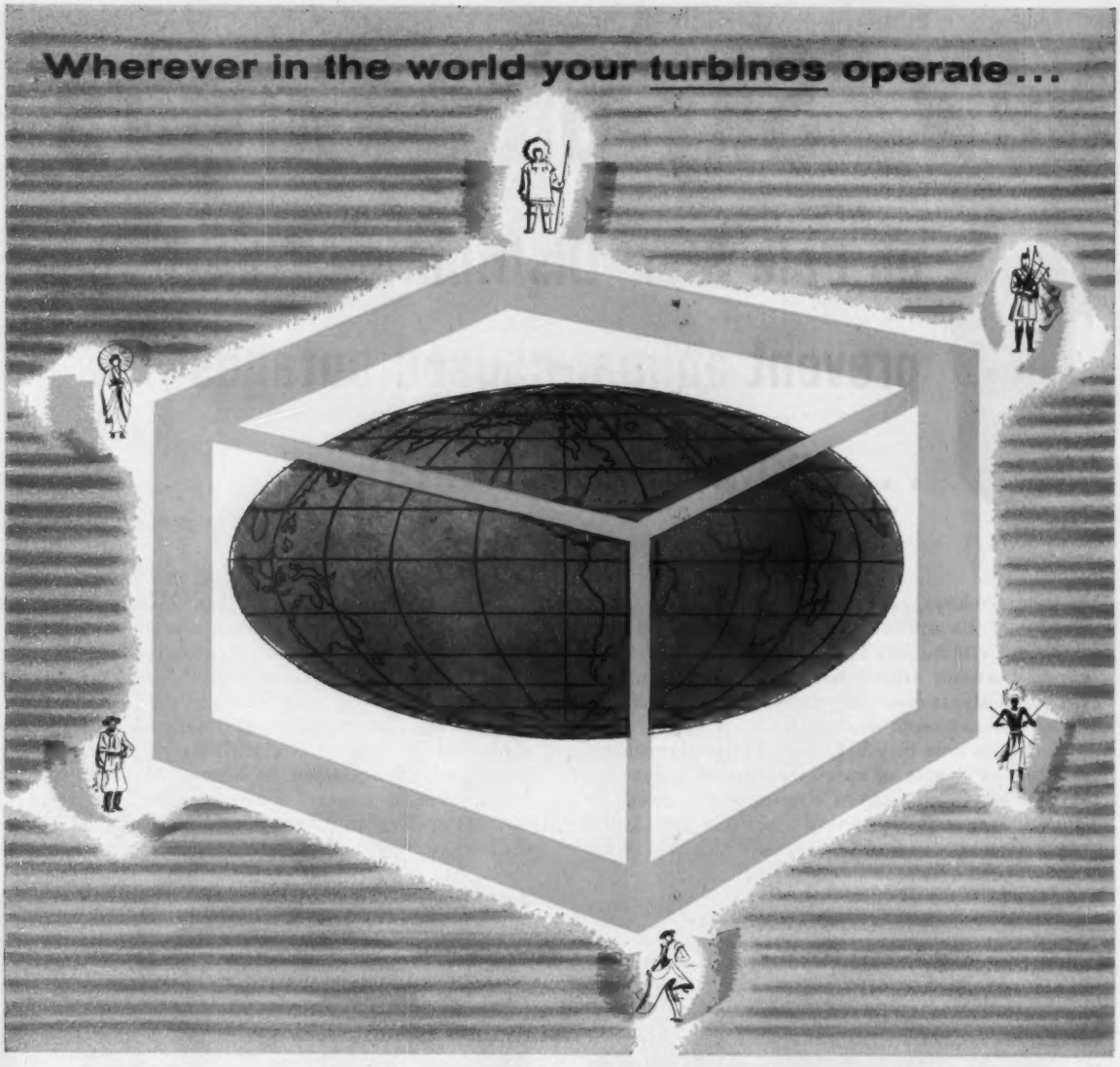
A bonus feature of Pole Star's new Sky-blue Covers is the absence of external bushing clamps. This eliminates potential dirt collectors and sources of corrosion, and also improves transformer appearance. The internal ring-clamps assure uniform pressure at all points for maximum gasketing effectiveness. Gaskets are made of nitrile rubber—a long-time standard of Pole Star Distribution Transformers because of outstanding resistance to oil, heat, cold, moisture, dust, and other detrimental conditions.



Outstanding resistance to impact, scraping, corrosion

Repeated blows from a hammer illustrate the ability of Sky-blue Covers to withstand impact without chipping. In other tests, Sky-blue Covers were blasted for three minutes with steel grit without exposing any bare metal—truly *amazing* resistance to abrasion! Also, Sky-blue Covers were in better condition after *3000 hours of exposure to salt spray* than uninsulated covers were after but 1000 hours. Such ruggedness eliminates any necessity for "kid-glove" treatment during handling and installation.

DISTRIBUTION TRANSFORMERS



Other outstanding Shell Industrial Lubricants available world-wide

Shell Tellus Oils – for hydraulic systems

Shell Alvania Grease – multi-purpose industrial grease

Shell Rimula Oils – for heavy-duty diesel engines

Shell Talona R Oil 40 – anti-wear crankcase oil for diesel locomotives

Shell Dromus Oils – soluble cutting oils for high-production metalworking

Shell Macoma Oils – for extreme pressure industrial gear lubrication

Shell Voluta Oils – for high-speed quenching with maximum stability

AN INTERESTING FACT!
Every Shell Branded Industrial Lubricant is named for a sea shell. Shown here is the Turbo crassus.

Shell Turbo Oil is there

Around the world, Shell Turbo Oil is available—under the same brand name and providing the same outstanding performance. This is assurance that your customers abroad will enjoy the superior turbine lubrication that domestic customers insist upon.

Shell Turbo® Oil provides these 4 outstanding reasons for its acceptance as a top-rated lubricant for utility, industrial and marine turbines: (1) It has exceptional oxidation stability for maximum service life. (2) It separates readily from water. (3) It protects against rust. (4) Its performance does not vary—make-up oil is identical to the original charge regardless of time of purchase.

No matter where your turbines operate, make Shell Turbo Oil your standard recommendation. Write for complete information.

SHELL OIL COMPANY

50 WEST 50TH STREET.....NEW YORK 20, N.Y.
100 BUSH STREET.....SAN FRANCISCO 6, CALIFORNIA
IN CANADA: SHELL OIL COMPANY OF CANADA, LIMITED
505 UNIVERSITY AVENUE.....TORONTO 2, ONTARIO

SHELL

Hot reheat pipe of new 325,000 KW unit No. 5 at Pacific Gas and Electric Company's Pittsburg Power Plant in California, showing line-up of 3 Grinnell Constant Support Hangers.

Grinnell Hangers support piping at Pittsburg Power Plant

Grinnell manufactures a complete line of engineered pipe hangers and supports. Where reactive forces at terminal points must be kept within specified limits, Grinnell Constant Support Hangers are recommended. They are designed to provide an exact supporting force equal to the pipe load throughout the entire range of travel.

When pipe lines are subject to vertical movement and restrictive conditions do not require the use of a constant support type, Grinnell Variable Spring Hangers are recommended. They should be designed to support not less than 85% or more than 120% of the designed load for the total travel.

When necessary to prevent abnormal movement or vibration in pipe lines, Grinnell Sway Braces of the energy-storing, instant-acting, counter force type are available.

Grinnell maintains a staff of trained technicians; provides highly skilled assistance and advice right from the design stage; offers experienced field engineering service. Call on Grinnell next time. Grinnell Co., 277 West Exchange St., Providence 1, R. I.

Closeup at Grinnell Variable Spring Hanger supporting boiler feed pipe.

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AMERICA'S #1 SUPPLIER OF PIPE HANGERS AND SUPPORTS

Pipe Fittings, Valves, Pipe Hangers, Prefabricated Piping, Unit Heaters and Piping Specialties
Branch Warehouses and Distributors from Coast to Coast

Single sideband system for power line carrier communications

By Roland U. Sandmeier, Project Engineer, Brown Boveri Corp.

BROWN BOVERI

In many cases, power line carrier (PLC) is the lowest cost communication system for utilities and the most reliable. In addition, Brown Boveri's single sideband (SSB) equipment allows use of smallest bandwidth and offers flexibility to solve the most intricate communications problems. It is used in 32 countries on 5 continents with many extensive, complete power systems in Canada.

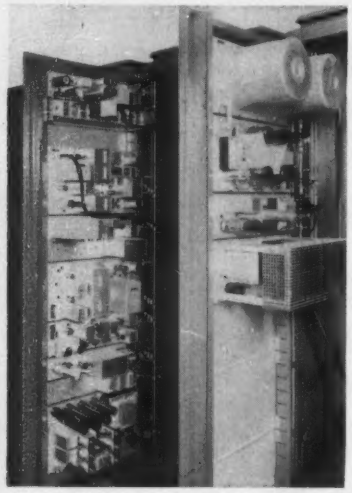
For voice, telemetering, remote control, protection relaying, teletype.

Several links may be connected in series without impairing the quality of either voice or superimposed control channels.

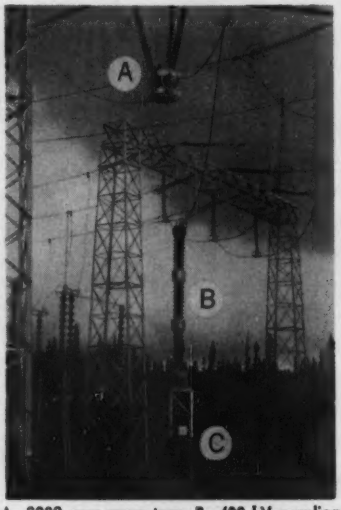
The system is as reliable as a modern telephone network. For example, the Swiss PLC network, extending over an area of only 10,000 sq. miles, consists of about 170 stations and uses over 360 Brown Boveri transmitter-receiver sets in a fully automatic dial system.

Simple, rugged equipment; high power output for long lines and high voltages.

PLC equipment uses relatively few tubes or transistors. Built-in tube checking devices simplify maintenance even by unskilled personnel.



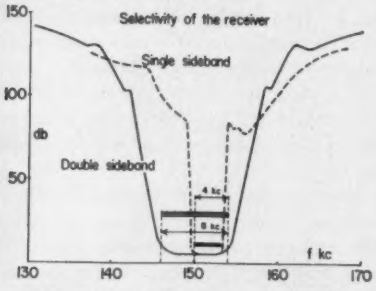
Left cabinet: Basic SSB set. Right cabinet: 100W power amplifier.



A—2000 amp wave trap. B—400 kV coupling capacitor and potential device. C—Protective device.

Twenty, 100 and, if necessary, 250 watt output is available to meet the most adverse conditions. Single-hop transmission over 350 miles on a 380 kV line carries voice and protection-relaying tripping signals with reserve power to overcome ice, rain, fog.

Broadband coupling with high-impedance line traps and high-capacity coupling capacitors gives balanced transmission conditions, allows repeated use of the same frequency. Line traps are available for currents up to 2000 amps and coupling capacitors for up to 460 kV. Line traps on all links and taps insure excellent transmission under all switching conditions.

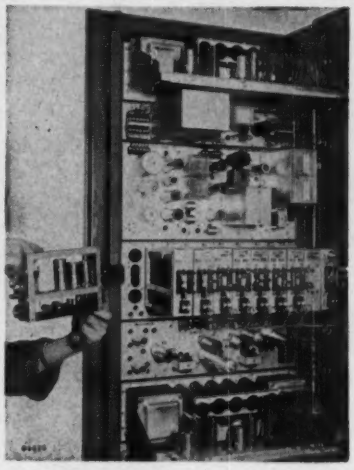


Single sideband allows adjacent transmitting and receiving channels.

Smallest bandwidth, adjacent channels.

SSB requires only half the bandwidth of either FM or DSB.

All signals (voice, telemetering, etc.) are carried by a 4 kc band; where channels are crowded, only 8 kc are needed for duplex communication with transmitting and receiving channels adjacent. Where voice only is required, bandwidth can be reduced to 2.5 kc for one direction and 5 kc for full duplex with adjacent channels. Rapid cyclic (time multiplex) telemetering, developed by Brown Boveri, handles up to 38 telemeter measurands on 400-cycle bandwidth . . . greatly expanding the capacity of an SSB channel.



Rapid-cyclic telemetering equipment. Receiver for 8 measurands.

Flexibility.

A 4 kc SSB link may be used for voice only, then adapted for as many as seven control channels without any change in basic equipment.

Best signal-to-noise ratio.

Presuming DSB carrier power is equal to SSB sideband power or total FM power, SSB is 6 db less sensitive to noise than DSB and 1.2 less than FM. Although the latter difference is small, SSB quality is much better than FM because of distortions in narrow band FM.

BROWN BOVERI Brown Boveri Corp., Dept. EW10, 19 Rector Street, New York 6, N. Y. Agents in 27 U. S. cities

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COST-FREE PLAN...

Save up to 80% of your programming costs... put solid state IBM 7070 to work for you... faster.

Ready to use—right off the shelf—IBM's pretested utility program* slashes the time and cost of getting your Customer Billing and Accounting into full-scale operation on the 7070.

Based on IBM's many years of experience in solving the data processing problems of public utilities, this program is designed to meet the unique requirements of each installation. As a result, up to 80% or more of your problem definition, block diagramming and programming is available to you—immediately. Your feasibility studies are greatly simplified and shortened. You realize full return from your machine investment months, perhaps even a year, sooner.

This cost-free program is another step forward in IBM's never-ending effort to provide you with all the services you need for truly Balanced Data Processing.

Your local IBM representative will be glad to show you a color movie demonstrating how this new IBM service can save you time and money—improve your customer accounting. Call him today.

*Customer Billing and Accounting on the IBM 7070 is another program from the expanding IBM Programmed Applications Library.

BALANCED DATA PROCESSING **IBM**®

Pile on the ice and snow!

Let it sleet. Let it snow. Let the wind blow.

This cable can weather the storm.

Rome's reverse-lay preassembled aerial power cable has a built-in, high-strength messenger for staunch support. Falling branches—even some trees—can be supported by the cable itself!

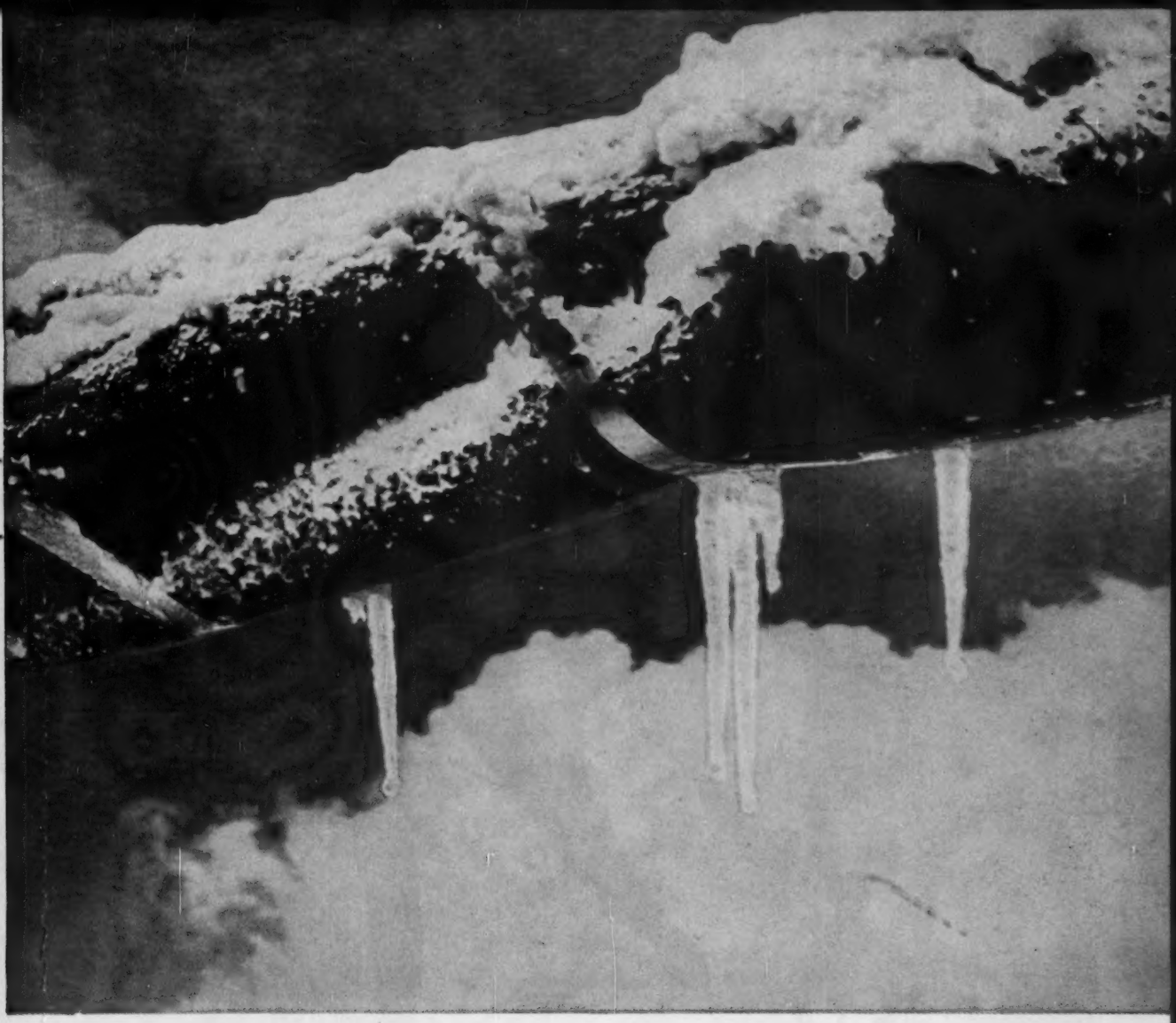
Fewer outages You can use this aerial cable to reduce the chance of outages during storms and high winds. Because it is fully insulated and jacketed for maximum resistance to moisture and tree abrasion, it prevents wet branches from shorting between phases. And it's *safer* for your line crews to handle . . . safer for the public too!

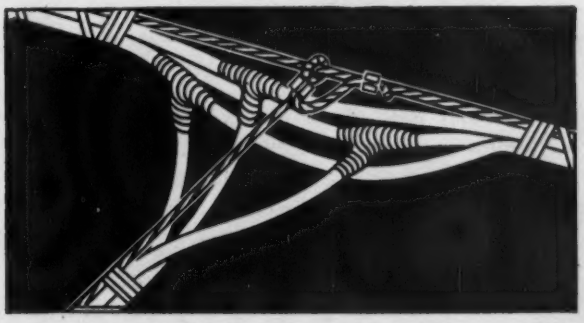
Routing more direct Because it is compact, you can route preassembled aerial cable more directly, with less right of way than is required for open-wire systems. You can run more circuits in less space. Less clearance is required, so you do less tree trimming—initially and periodically!

Wide range of constructions You can get Rome's preassembled aerial power cable in a wide range of constructions, rated up to 15 KV: Rozone (oil-base), Polyethylene, or Rozone A (butyl-base) insulation, Roprene (polychloroprene) or Roseal* (flame-retardant polyethylene) jacketing.

Get all the details from your Rome Cable salesman, or clip and mail the coupon today!

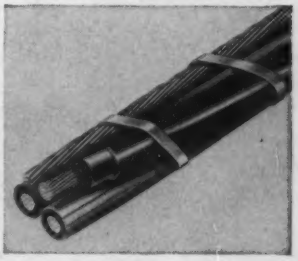
*Trade mark—Patented.





EASE OF TAPPING Long spans sometimes make mid-span tapping necessary. Rome's reverse-lay preassembled aerial cable construction—where the direction of lay of conductors is reversed at regular intervals along the line—permits easy mid-span tapping. The reversed portions provide sufficient slack for taps *anywhere* along the line! This eliminates the necessity of making taps at the pole ends only. Stress is carried entirely by the messenger. Conductors can be untwisted for tapping without cutting—even while the line is hot if conductors are unshielded (5 KV). Your linemen can use wire guards and rubber blankets for safety and make pole-end taps without use of a platform.

BETTER VOLTAGE REGULATION Because of its close geometric spacing as compared with open-wire circuits, aerial cable has a lower reactance. Voltage drop is about half as great as typical crossarm construction and, for a given voltage drop, power can be transmitted twice as far.



ROME CABLE
DIVISION OF **ALCOA**
Department 1100, Rome, N. Y.

☐ Please send me more information on the above.

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Company .....
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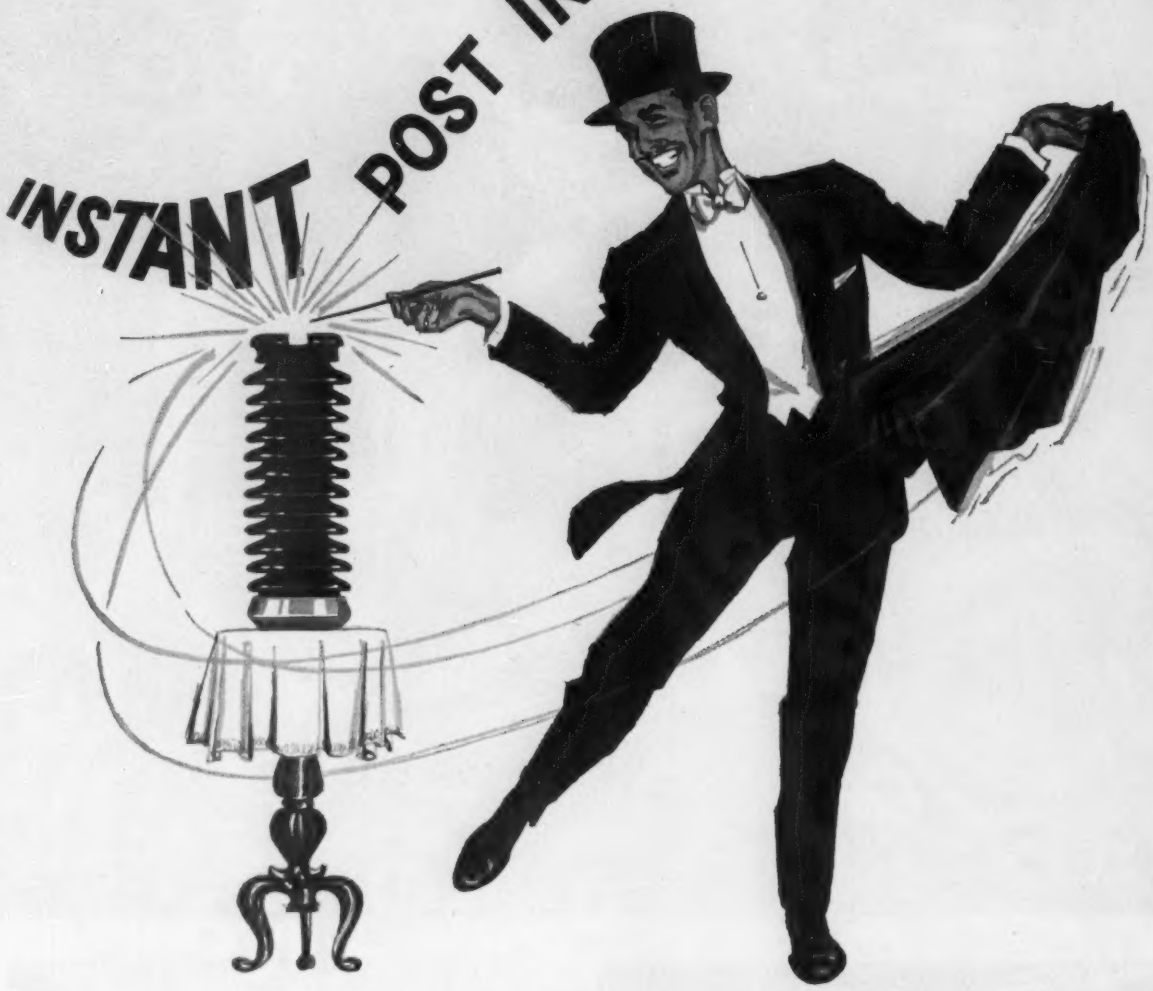
City ..... Zone ..... State .....

ALCOA
ROME CABLE
DIVISION

INSTANT POST INSULATORS ?



Not yet. Lots more to it than "Let's get into the Line Post and Station Post business." Yet as more and more power companies standardize on Lapp's better insulator design, more and more imitations crop up.

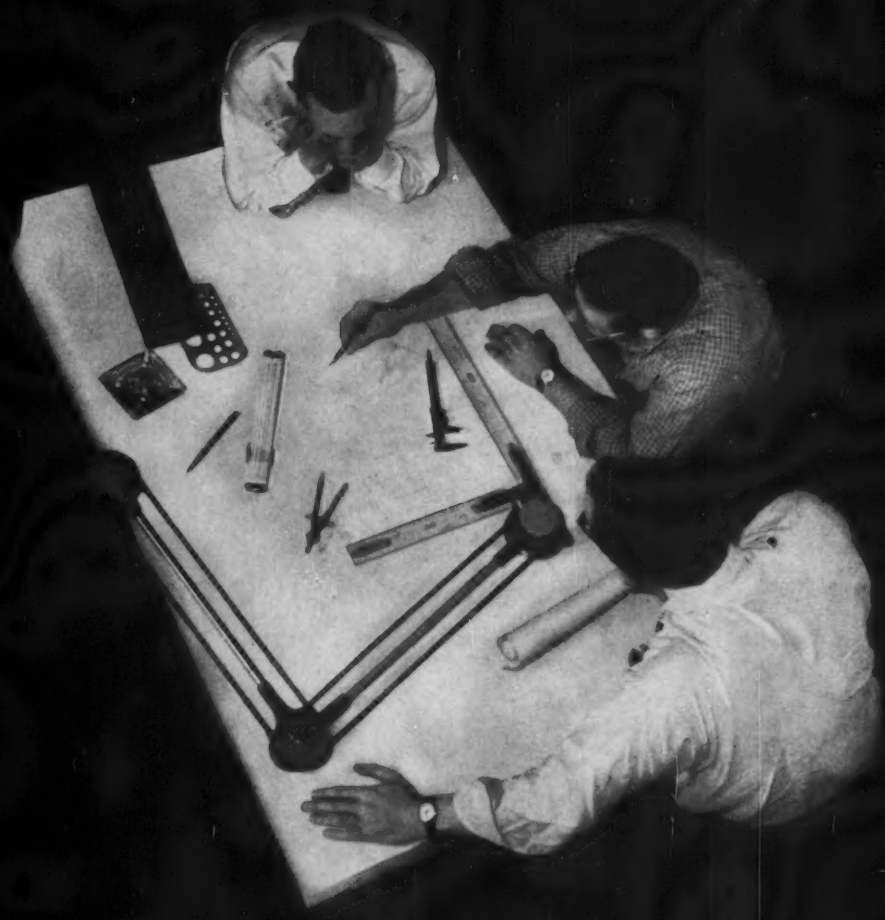
Pretty good copies, some of them—in looks. Funny thing, though, you don't see many around. Partly because they couldn't copy the most important thing: Lapp's 30 years of taking out the bugs, putting in the failure-free performance characteristics.

Your only reasons for specifying Line Posts and Station Posts on your systems are for fewer interruptions of service, lower maintenance and replacement costs. Makes sense to get them from the company that pioneered, proved and perfected them.

Lapp

New Lapp Catalog Eight tells lots about Line Posts and Station Posts. Write for your copy.
Lapp Insulator Co., Inc., Le Roy, New York.

CONCENTRATION



RT&E was founded and operates today on a very basic premise: do one thing and do it better than anyone else. That's why you'll find engineers at RT&E thinking and doing things with transformers that nobody else has ever done . . . why engineering talent at RT&E is concentrated on *one* idea . . . a better transformer. This concentration can pay off for you. Proof? Write for Bulletin 101.

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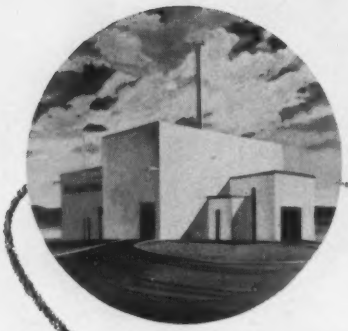
First all-privately-financed nuclear station: jointly owned by General Electric Co. and Pacific Gas and Electric Co., at GE's Vallecito's Atomic Laboratory in California. Bechtel was the engineer-constructor.

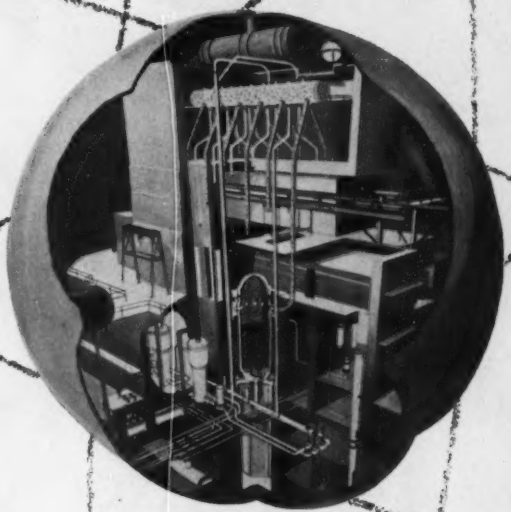
1957



1951

First generation of nuclear electric power: Experimental Breeder Reactor, A. E. C. National Reactor Testing Station, Idaho. Constructed by Bechtel.

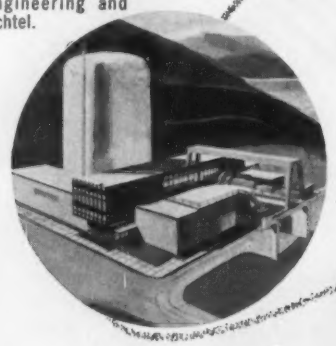
1960

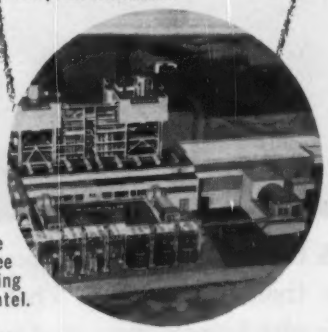


America's largest all-nuclear power plant begins operation: Dresden Nuclear Power Station, Illinois, Commonwealth Edison Co. Capacity: 180,000 kw. Nuclear Power Group, Inc. contributed to research and development costs. Bechtel was the engineer-constructor for General Electric Co., the prime contractor.

1963

Prototype Nuclear power plant: Peach Bottom Atomic Power Station, Pennsylvania, Philadelphia Electric Co. General Atomics high temperature gas cooled reactor will have a capacity of 40,000 kw. 53 utilities are participating in research and development. Engineering and construction by Bechtel.





1962

Nuclear power addition to existing conventional plant: Humboldt Bay Power Plant, California, Pacific Gas and Electric Co. General Electric BWR unit will have normal rating of 50,000 kw. One of three fixed price nuclear power projects being engineered and constructed by Bechtel.

a lifetime of experience in nuclear power...

ALL IN 12 YEARS

1960

22,000 kw nuclear power demonstration project near Chalk River, Ontario, for Canadian General Electric Co., Ltd. Canadian Bechtel is procuring, installing, and testing the mechanical and electrical process equipment, control and instrumentation.

1962

Nuclear power plant: Big Rock Point Station, Michigan, Consumers Power Co. General Electric BWR unit will have initial capacity of 50,000 kw and a potential up to 75,000 kw. Engineering and construction by Bechtel.

Bechtel experience spans the entire lifetime of nuclear-electric power—beginning with the construction of the first plant in which the incredible energy of the atom was transformed into electricity. It has continued through engineering-construction responsibilities that include Dresden and the other significant projects shown around the sphere.

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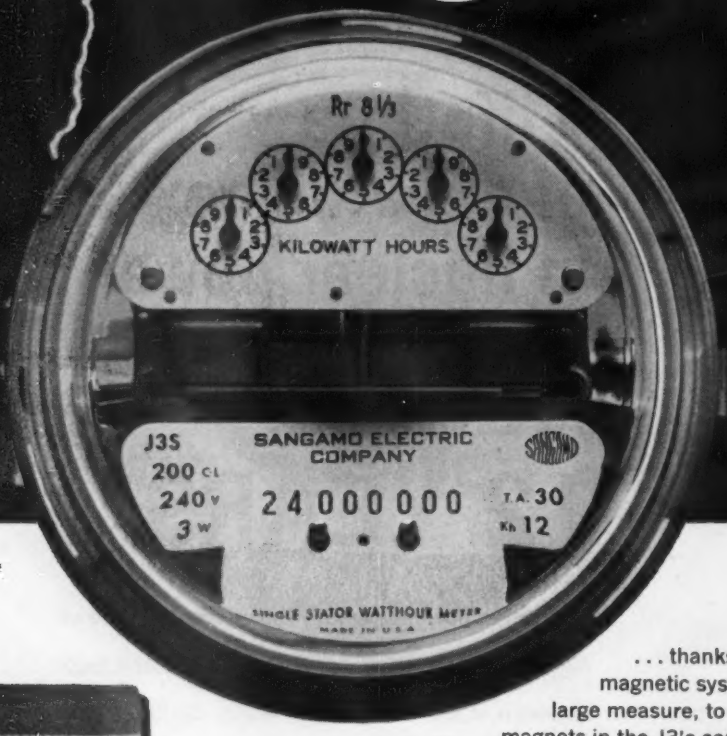
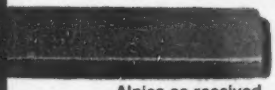
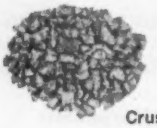
THE SANGAMO J3 SHRUGS OFF SURGES



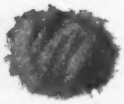
. . . thanks to the permanence and stability of its magnetic system. Permanence and stability due, in large measure, to the high quality and uniformity of the magnets in the J3's controlled floating system.



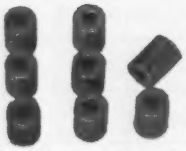
Alnico as received



Crushed



Ground



Bonded Alnico Magnets

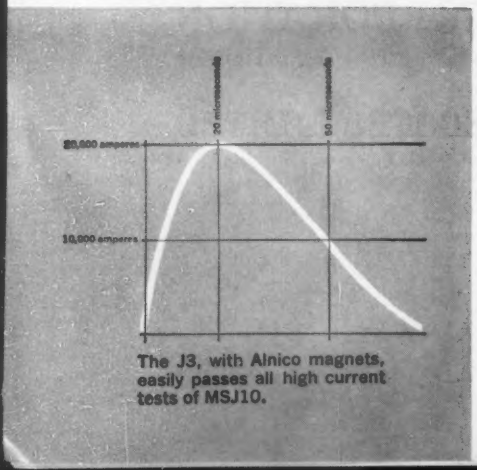
These magnets are made by Sangamo. Made of bonded Alnico. Extra-high coercive force Alnico material is crushed and ground into a fine powder, then bonded into magnets . . . dimensionally and magnetically uniform magnets that have none of the variable characteristics associated with cast and sintered magnets. Each magnet is also thoroughly factory-aged to make sure its strength will not diminish through long years of service.

Actually, all of the components of the J3 are virtually unaffected by high surge currents—even after repeated surges of 20,000 amperes through the neutral wire and 2,000 amperes through the current coils. This includes the electromagnets as well as the Alnico floating system and damping magnets. Surges and short circuits which can de-magnetize even the best chrome steel magnets can't affect the J3 Alnico magnets.

The true magnetic floating system of the J3 never requires maintenance or replacement and is guaranteed for the life of the meter. That's just one of many good reasons why the J3 is your best investment in watthour meters.

Other reasons? A visible, self-cleaning gap; substantially reduced side thrust; insignificant tilt error; advanced insulation level; smallest size; better visibility for inspection and testing; highest torque; slowest speed; lowest watts loss; sectionalized construction; corrosion-resistant finishes and materials; glaskyd base.

Your Sangamo Representative has the complete J3 story. Get it; you'll discover that the J3 has everything you want in a watthour meter. And that's a promise, for this is one of the really great ones.



The J3, with Alnico magnets, easily passes all high current tests of MSJ10.

SANGAMO ELECTRIC COMPANY
SPRINGFIELD, ILLINOIS

J3

JH60-9

Electrical World

OCTOBER 3, 1960

Editorial Comment

The Retreat From 1,100F Steam

For the second time in three months a leading pioneer in the use of high temperature steam has publicly announced withdrawal to a lower temperature in future capacity additions. In both instances high cost of austenitic steels and limitations on their life at 1,100F played an important role in the decisions. The effect of these announcements has been to give new and significant emphasis to the metallurgical barrier that today blocks power plant designers from further improvement in thermal efficiency.

Speaking to the National Power Conference in Philadelphia on Sept. 22, Robert A. Baker said that cost of austenitic steel today is such that Public Service Electric & Gas Co cannot justify its use in future unit designs. While regretting this deviation from 1,100F, Baker said it will be necessary to reduce design steam conditions of new units to 3,500 psi and 1,000/1,000F. As soon as ways can be found to install steels at prices consistent with thermal gains, there will be a return to austenitic steels. Meanwhile, Baker hoped manufacturers could learn to use such materials at lower cost.

Only three months before, at the World Power Conference in Madrid, Philip Sporn indicated that American Electric Power Co's next large unit might not use steam temperatures much above 1,000F because of the high cost of austenitic steel and limited endurance of boiler components in the 1,100F range and above. Moreover, he warned Belgian and British utilities which are now considering these temperatures against over-optimism based on early trouble-free operation.

Few utilities are in a position today to question the experience from which these observations are made; Public Service E&G and American Electric Power have been in the forefront of high temperature steam development long enough to have accumulated a substantial volume of data on the performance and cost of austenitic steels in the 1,100F region.

It is to be hoped that their dramatic withdrawal from use of austenitic steel at 1,100F and above will stimulate the extra effort necessary to achieve a significant breakthrough in metallurgy. Such a breakthrough is necessary to justify not only an early return to 1,100F but also an advance in temperature that will bring compensating thermal gains.

Candidates Affirm Platforms on Hydro Development

Last Monday's Kennedy-Nixon TV debate defined the candidates' postures on hydro development, if anyone doubted each would follow his party line.

Sen Kennedy is firm for federal development. His amazing statement that hydro production is the "hallmark of an industrialized society" might surprise the British, but it spells out his program more clearly than could figures on projected new starts.

Vice President Nixon could have refuted this parochial stand. He did not, for he obviously accepts hydro as a political issue.

But his clear call for continued participation by "the biggest segment of all—individual enterprise," in economic growth, makes his adherence to the partnership principle in hydro development a certainty.

On this issue, we'll take Nixon.

Vennard: Co-ops important link

Harrison: Counsel together

Hamil: More load-building

EEI and co-op spokesmen . . .

Stress Cooperation

On the program it was a load-building idea exchange, but on the sidelines, an important effort at improving relationships between rural electric cooperatives and investor-owned utilities was constantly in progress. Both facets of the recent 7th Annual National Inter-Industry Farm Electric Power Conference in Louisville, Ky., were pursued with enthusiasm by some 550 delegates.

The Farm Power Conference, provided a common meeting ground for co-op and investor-owned utilities to meet, talk and work out their difficulties. The strongest reference to the problems that exist was made by Walter Harrison, president of the National Rural Electrification Assn, who said:

"Today . . . we have seen about 97% of the farms electrified. That is a notable achievement. It has been done because there have been men of vision, men of understanding of problems of the farmers, men who are willing to give of their best, and I would like to add, there has been cooperation, in the main, for the most part, on behalf of the private utility industry. Of course, here and there, you will find someone that sounds a discordant note, but in the main we have enjoyed their cooperation. I would like to add further that there is a place in this great nation of ours for the private utility industry, for the cooperative enterprise, for the municipal systems, and for federal undertakings."

Harrison spoke of good results from conferences between co-ops and investor-owned utilities in Georgia, finally resolving a nine-year battle over disposition of power from the Clark Hill Project, federal installation on the Savannah River.

He said: "Today, in Georgia, the representatives of the rural electric cooperatives are able to sit down at the conference table whereever there are conflicts of interests between the cooperatives and the power suppliers. We should counsel together to seek rightful solutions of the problems prevailing."

Before the end of this year, Harrison expects that a code of ethics will be drawn up for co-ops and investor-owned utilities to follow. He expressed hope that upon its completion, this would lead the way to harmony and progress.

Edwin Vennard, Edison Electric Institute vice president and managing director, brought out some of the hard economics that will probably lead to even greater cooperation between co-ops and their suppliers.

"The evolution in the power business has been from the isolated plant to the large central stations, from transmission interconnections within a company gradually to interconnections between companies. These interconnections between companies have resulted in larger and larger power systems with greater and greater diversities and higher efficiencies."

Vennard talked about progress in power pools and the many technological advances that have been made in steam pressures, temperatures and transmission voltages, and their resulting economies. Relating this to cooperatives, Vennard said:

"For years the cooperatives have been an important distribution link in America's giant power system. The system has grown, the load patterns in rural areas have called for the construction of transmission lines which were built to serve this growing load. The resulting system is integrated and efficient. The cooperatives are part of it and contribute to its effectiveness in performing its main objective—getting power to people. Making use of the facilities of such a system offers very real economic advantages to a cooperative. System diversities, size of units, and comparative cost of maintaining adequate reserves represent definite avenues to economy open to a large system but not always available to a small one."

He concluded with: "Management—of either the companies or the co-ops—would indeed be remiss if it overlooked any way to handle

at Farm Power Conference

system problems more efficiently through joint work with its neighbor.

As keynote speaker, REA Administrator David Hamil pointed out that Rural Electrification Administration has nearly achieved "horizontal" coverage of the farm market, and urged that through the Farm Power Council, as well as local and regional efforts, the "vertical" coverage—load building—become the new goal of co-ops and companies.

"Cooperation is the magic force that can help all of us to accomplish more than we could working alone. Let's all keep that in mind as we begin the electrifying Sixties."

Electric heat had the spotlight as the greatest potential for farm home loadbuilding. R. S. Crist, supervisor of electric farm services for West Penn Power Co, described written specifications, for installation of electric heat, prepared by the Pennsylvania Electric Council.

The specifications require enough wattage to produce and hold 75F, and recommend that not more than 10% in excess of the calculated heat loss be installed. They include detailed information on insulation, treatment of floors and basements, and ventilation in various rooms.

Crist said the standards were used in sales presentations so the customer would know what is involved in preparing his home for electric heating. There was some dealer reluctance at first, but the specifications proved a good sales tool.

Crist cautioned: "Before anyone jumps to the conclusion that the issuing of standards automatically guarantees their being followed, I would like to caution you that you will still have a selling job. You must first convince your own people and then your dealers."

FPC-Appalachian Accounting Case Postponed

Utility asks delay in hearing on one FPC order until circuit court order rules on subsequent one

Legal complications have delayed an FPC hearing on Appalachian Power Co's alleged violation of FPC accounting procedures for deferred federal income tax accruals. The hearing has been postponed from Sept. 12 to Oct. 17—and may be delayed even more.

The FPC complaint against Appalachian was issued last October on grounds that the company had failed to account for its deferred income taxes in FPC accounting categories 507-A and 266, as required in a 1958 Federal Power Commission order (No. 204).

Similarly, the FPC issued complaints against 10 other companies in the fall of 1959, but the present hearing involves only Appalachian. Intervenors in the Appalachian case are New York State Electric & Gas Corp and the West Virginia Public Service Commission.

Appalachian asked FPC Presiding Examiner Edward Marsh to postpone the hearing until the Fourth Circuit Court could rule on the company's petition challenging the legality of another FPC order (No. 216) which, Appalachian claims, modified the first FPC accounting order. However, FPC staff attorney Drexel Journey opposed such a lengthy delay. Journey wanted to postpone the case only on a "week to week" basis—to keep it high on hearing priority—until both Appalachian and the FPC staff could complete filing of opposing legal briefs before the appeals court. The FPC staff is filing a motion for the court to throw out Appalachian's petition.

Further Delay Possible

Marsh split the difference, denying both Journey's "week to week" plan and Appalachian's request to postpone until the court rules. The Oct. 17 date chosen by Marsh is the first Monday after the court's date to accept the opposing briefs. Marsh will decide at that time whether to proceed with the hearing or grant further delay.

Journey claims that FPC order No. 216 (which the company has taken to court) has no bearing on the previous accounting requirements. He said order No. 216 doesn't modify the earlier order No. 204; it is merely an interpretation.

Appalachian attorney Chester Davis disagreed strongly: "We are being asked to defend ourselves against what I might describe as an indictment at the very time we don't know what the indictment is." He said the court should be allowed to rule on the company's petition first, so that Appalachian would know whether it should be prepared to "defend ourselves, or to justify our course of conduct based on the wording of the language, or the meaning, or the effect" of FPC order No. 204, and/or FPC order No. 216. Davis added that Appalachian's original impression of FPC order No. 204 was that it was permissive, not mandatory, anyway.

A similar accounting case, involving Kentucky Power Co, is now under way at the Securities & Exchange Commission. Davis pointed out that, while the SEC case involves another company, both companies are in the same system—American Electric Power Co—and it would be helpful if the two cases weren't stacked on top of each other.

How Will Kentucky Co-op Use 100-Mw More?

Where does East Kentucky Rural Electric Cooperative Corp intend to sell the power it will gain from a proposed generating plant at Burnside?

That's Kentucky Utilities Co's big question in Public Service Commission hearings which will resume Oct. 8 with direct testimony by KU witnesses against the project.

The Rural Electrification Administration last month approved the co-op's request for a $25-million loan which will be used to build a power plant, six substations, and 342 miles of 161 and 69-kv line. The new loan will bring the total lent to RECC to $66.5 million. The co-op already owns 154 Mw in steam generation, and 1,158 miles of transmission.

RECC, which serves 16 co-ops in 80 counties, has asked the PSC for authority to build a power plant which will provide 100 Mw initially and 500 Mw by 1975. Its initial cost would be $25 million, with an $80-million eventual cost. RECC presented its case last June and KU counsel cross-examined RECC witnesses at a hearing last month.

KU spokesmen contend that "this generating capacity is not needed and, in fact, cannot be utilized for any legitimate objective of rural electrification in Kentucky. The size of the rural loads in Kentucky are such that this capacity cannot be used to serve them."

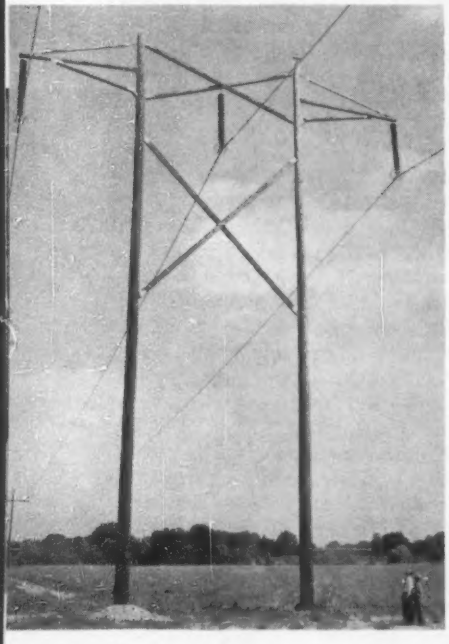
RECC traditionally has served the rural areas, including towns of more than 1,500 population, while KU furnished electricity to larger cities and industry. Malcolm Marshall, KU attorney, tried at the August hearing to find out if RECC had any long-range plans to serve cities and industry, but the question went unanswered. Commission Chairman David Francis said such information, disclosed now, could impair RECC's bargaining power for a new contract.

A KU spokesman said, "The activities of some of the distribution co-ops which are members of RECC and the testimony of the RECC manager in this proceeding demonstrate the purpose of RECC and the co-ops is to use this proposed capacity to serve industrial and urban loads contrary to the intent of the federal rural electrification loan act."

Kentucky Utilities had maintained that the loan for the co-op power plant should not be approved.

"This is not rural electrification," the spokesman declared. "Figures published by the Department of Agriculture state that as of December, 1959, about 98% of the farms in Kentucky were already electrified."

Witnesses at the August hearing said RECC intends to sell increased power according to terms acceptable to the 16 co-ops, which sell directly to consumers. They said RECC could save more than $1 million a year for 10 years with the new plant.



Illinois Power Tests Novel 345-kv Wood Pole Line

Illinois Power Co has recently started tests on a one-mile, three-phase 345-kv line using an unusual wood pole design. The line, shown in the photograph at the left, will be subjected to comprehensive tests for a period of approximately two to three years to determine if wood pole structures of this design are feasible for the power company's future transmission requirements at such voltages.

The 345-kv trial transmission line is located near Terre Haute, Indiana, at the Breed Generating Station of the Indiana & Michigan Electric Co, an American Electric Power Co subsidiary. American Electric Power Co is co-operating with Illinois Power Co on the tests. Breed Station will be dedicated this month.

Commonwealth Files for Full License for Dresden

At hearings before an Atomic Energy Commission hearing examiner, Commonwealth Edison Co officials last week said the company is now ready, willing and able to operate the Dresden Nuclear Power Station under a full power, 40-year operating license.

In applying for the final operating license, Commonwealth Vice President Murray Joslyn and its attorney, Arthur Gehr, reported the plant satisfactorily reached non-sustained 180-Mw full capacity runs in tests previously authorized under a provisional AEC license last June. Commonwealth crews are now operating the reactor.

AEC's legal and technical staff have no objections regarding safety of the reactor nor financial qualifications of Commonwealth. Commission Staff Attorney Lionel Kestenbaum filed with Hearing Examiner Samuel W. Jensch a suggested consent order covering mortgage liens on the reactor held by Commonwealth creditors. The commission is required by the Atomic Act to give its consent to mortgages and pledges on any nuclear facility owned by one of its licensees. For the protection of public health and safety, no reactor license granted by AEC to one party may be transferred without commission consent.

Meantime, Commonwealth officials, anticipating no major delays in obtaining the final license, have scheduled Dresden dedication for Oct. 12.

Installed Capacity of Electric Power Stations (Mw)			Production Per Capita in Kwhr/Year		
Country	1950	1958	1950	1959	1965
Albania	....	....	17	106	?
Bulgaria	176	850	110	497	1,227
Czechoslovakia	2,801	4,668	749	1,615	2,617
East Germany	4,842	6,770	1,059	2,145	3,590
Hungary	776	1,327	321	716	962
Poland	2,032	5,571	380	901	1,326
Rumania	740	1,507	130	372	1,008
Total	11,367	20,693	.....	.....	.....
USSR	19,614	53,367	506	1,255	2,137 to 2,222

Capacity and output in Soviet satellites climb as . . .

East Europe Pushes Electrification

A strong drive for greater electrification, often without regard for cost, may make the seven East European Russian satellites a major power producing group by 1965. Operating under a Russian-dominated planning group, which controls every aspect of system planning, the satellites are aiming for 192.5 billion kwhr by 1965, to serve a population of about 96 million.

In terms of relative growth, a recent UN statistic indicates that in the past 10 years the European satellites' power output has grown faster than Western countries. In 1959, their power output was 2.3 times that of 1950, against 1.9 times for the Western countries.

But the surge in power growth is more apparent than real. The satellites, most of them backward and poorly electrified, started with very low outputs, which makes relative comparisons misleading.

How are the individual countries faring? The summary above, compiled by a McGraw-Hill correspondent from published communist planning directives, provides a relatively accurate survey.

Hungary at present is unable to meet her domestic requirements, in large part because almost 25% of her power is consumed by the aluminum industry, the sixth largest in the world. Installed capacity in 1958 was 1,327 Mw. Plans call for commissioning three small stations, aggregating 100 Mw in 1960.

Hungary produces 50-Mw generating units domestically and plans to start production of 100-Mw units. A 600-Mw station, planned for the 1961 to 1965 period and comprising four Russian-built 150-Mw units, will use residual oil.

Poland, the third biggest producer among the satellites, is working to build a 220-kv all-Polish grid which will link new power plants in western Poland with the high consumer area in the center of the country. About half the 3,600-Mw new capacity between 1961 and 1965 will be based on sub-bituminous coal, which is expected to represent about 29% of fuel source in 1965, compared to 2.3% in 1958. Poland has no hydro.

Industry Gets Priority

Specific consumption per kwhr has decreased from 2.2 lb to 1.3 lb in the last 10 years. As in other communist countries, industry gets first call on power use and consumes 78% of the nation's electricity.

Bulgaria, Europe's second smallest power producer before World War II, now exceeds Turkey and Greece combined in output. This satellite has based its growth on use of lignite and sub-bituminous coal. At present, only 32% of its power is hydro. Hydro installations are planned only where flood control and irrigation make multi-purpose installations possible.

Recent construction includes 50 to 100-Mw steam plants, using semi-bituminous, open-pit coal, and one new hydro plant. One 50-Mw plant is to go onstream this year with another 150 Mw to be added by 1962. Total capacity is to increase to 2,227 Mw by 1965.

Czechoslovakia, possessing East Europe's third largest lignite and sub-bituminous reserves, uses these fuels for more than 50% of its thermal power requirements. Current plans call for addition of 3,130 Mw from 1961 to 1965 and 2,000 Mw more from 1965 to 1968. About two-thirds of this new construction will be thermal plants.

The nation's first nuclear power plant, a 100-Mw unit built by Russia, is now under construction and slated to go critical in 1965. Czech power men are making an intensive effort to reduce fuel consumption to 0.956 lb per kwhr.

The Czechs are anxious to build, in co-operation with Austria, a 1,200-Mw run-of-river hydro plant on the Danube, but the Austrians as yet have shown no interest.

In Rumania, one of the largest oil-producers in Europe, 94.5% of all electric capacity is now thermal. A 10-year power development plan, adopted in 1950, calls for a boost in capacity from 600 to 2,500 Mw by expanding existing plants and building 19 new ones. Of these new plants, eight will be hydro and 11 thermal. The 1961-1965 plan foresees 2,380 Mw of new capacity, with 510 Mw from expansion of existing plants and 1,840 Mw of new capacity in seven plants.

BUSINESS MORALITY blocks socialism, H. A. Hitch tells Public Utilities Association of the Virginias. Other speakers (left to right) are E. C. Summers, new president, J. S. Smith, General Electric Co, and Mrs Charlotte Montgomery, Good Housekeeping magazine

Public Image Is Meeting Theme

How does the public's view of utilities affect their political and business future—this was the recurrent theme of the annual convention of the Public Utilities Association of the Virginias, held at White Sulphur Springs, W. Va., Sept. 16 and 17.

The keynote was set by H. A. Hitch, president of the association and vice president of Virginia Electric & Power Co. "Morals in business," he declared, "can be one of the big tools against socialism. Not that business has been immoral, but that may be the public conception of businessmen."

If we fail to use the tool of morals in business to the fullest, the public will surely demand more government in business for what it believes to be its protection. Business must strive for the plane of Caesar's wife, "above reproach," as one tool in keeping the blackness of socialism from spreading across the land, he continued.

If American business will not convince the American voter that the free enterprise system is best for him as well as for business, then it might be out of business, declared Dr Nicholas Nyaradi, director of the Institute of International Studies at Bradley University. Socialism is just as dangerous to labor as to management. Once attained, it destroys the economic power of the country in which it is established.

Commenting on the recent rise in interest rates, Dr Nyaradi said this measure stopped the flow of gold from the country, saved the dollar from devaluation and saved the earnings of the little man.

He maintained that although American business can't be beaten when it comes to selling products, it falls flat on its face in selling its own contribution to the economy. Pointing to the public-vs-investor-owned power controversy, he cited a case where businessmen would not include controversial information on the subject in pamphlets prepared to sell the free enterprise system, because they couldn't afford to antagonize some customers. If business can't do that today, it might be dead tomorrow.

Urges Reasonable Rates

Regulatory bodies are responsible for protecting the interests of all the people and that includes responsibility of helping the capitalistic system of private enterprise to function smoothly, Jesse W. Dillon, chairman of the Virginia State Corporation Commission told the convention. Dillon claimed it is not in the interest of the public to restrict utilities to minimum rates by which they can render minimum service, but rather to keep it strong and healthy so public needs can be met without delay.

Utilities are in the business of the automatic home and that involves the servicing of appliances to keep the home performing as it should, said Mrs Charlotte Montgomery, of *Good Housekeeping* magazine. Nothing makes the consumer "blow a fuse" quicker than having appliances that won't work and not being able to get service for them promptly, she warned.

Eric C. Summers, executive vice president of Monongahela Power Co, was elected president of the association for 1961, to take over Jan. 1. Other officers elected were Charles D. Lyon, to be first vice president, and G. South Dunn, second vice president. Lyon is a vice president of Potomac Edison Co; Dunn, director of public relations at Appalachian Power Co.

Business climate is man-made and a good one is priceless, J. Stanford Smith, general manager of General Electric Co's Outdoor Lighting Dept told the assembly. A good business climate is doubly important to utilities because they can't move.

In listing the steps to attain such a climate, Smith enumerated:

- Appraise the community's business climate.
- From the appraisal, determine short and long range objectives.
- Develop a timetable and set up teams with responsibility for attracting new industry and converting plans to accomplishments.
- Win community support.

Basic needs for a good business climate listed by Smith include:

- Impartial law enforcement. Violence has no place in a labor dispute.
- Good educational opportunities.
- Good illumination on streets and highways.

News Scope

Rate Hike to Yield 6¼%

Public Service E&G Co will apply, starting Oct. 3, new rates recently approved for essentially all electric and gas service by the New Jersey PUC. The rates are calculated to produce $10,163,000 a year increase (including a $3.5 million temporary increase on gas service authorized in Jan. 1959) which the PUC calculates will give the company a 6¼% return on its rate base. The expected increase, about 2.7% of last year's $369.5 million gross revenue, will be applied in nearly the same ratio to gas and electric rates. The company estimates that $4,268,500 of the increase will remain after taxes. The rate decision, handed down after hearings which started in April, 1958, also eliminated demand charges formerly applied to homes which exceeded 7.5 kw.

Would Outlaw Duplication

A proposal to prevent new duplications of lines and provide means of resolving existing duplications will be offered to the 1961 Oregon legislature by PUC Commissioner Jonel C. Hill. Present duplications in eight counties involve private utilities and PUD's, co-ops, or small municipals. Hill said the state now has "no workable certificate of convenience statute . . . relative to electric utilities."

Industries Oppose Rate Rise

A score of industries in Buffalo, N. Y., have asked the state Public Service Commission to reject Niagara Mohawk Power Corp's request for an $11,223,000 annual system-wide electric rate increase. Reportedly, the increase would cost western New York industries $1,794,092. The industries are represented by the Industrial Power Consumers Conference, composed of large power users in the area.

Atom Added to Three R's

In a novel program to bring a better working knowledge of nucleonics to the school classroom, some 250 teachers from the six New England states attended an "atomic energy conference" at the University of Massachusetts and at the Yankee Atomic Plant last month. Speakers from the Atomic Energy Commission and from Yankee Atomic Energy Co discussed present and future use of atomic energy and the technical and social problems that are associated with it.

Sponsoring the conference were the Massachusetts Commission on Atomic Energy, the Departments of Education of each of the New England states, the American Academy of Arts & Sciences (Boston), and other professional groups.

Dateline . . . The Campaign Trail (*Continued from page 5*)

to advance. The power needs of the future will dwarf the power needs of today.

"4. REA co-ops are not socialistic. The funds they receive from the federal government are not gifts or subsidies. They are business loans, repayable with interest. Repayments are well ahead of schedule. This is the kind of record we must help implement."

In California, Kennedy turned to federal projects: "We are going to reverse the policy of 'no new starts' on reclamation programs. I would like to make it clear that when the people put their shoulders to the development of great dams, then I think that power should be distributed in a way that benefits the people . . . I don't think the people should pay for irrigation and have the power distributed by a private company."

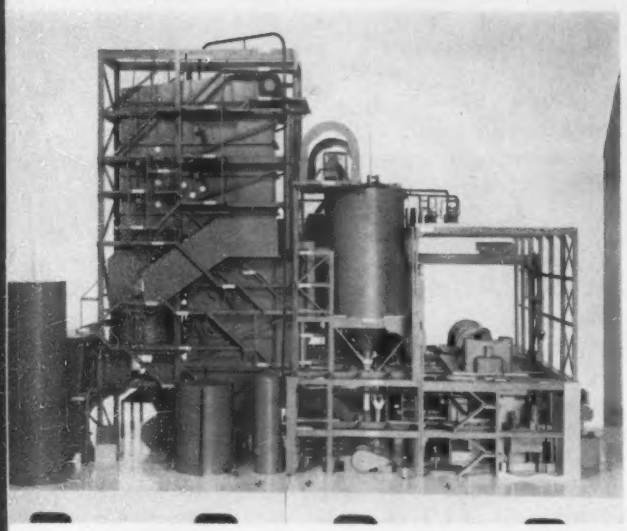
Nixon, speaking at Boise, Ida., and Portland, Ore., called for more new starts on federal multipurpose and reclamation projects in the Northwest: "A maximum effort" is needed to "develop to the full" the water, power and land of the 17 western states.

Nixon also criticized a Kennedy comment that the proposed Rampart Dam project in Alaska would already be developed, if Alaska still belonged to Russia: "This is apparently another case in which he (Kennedy) has shot from the hip in the heat of the campaign without thinking through the implications of what he was saying."

Nixon defended the Eisenhower power policies, stressing the "teamwork" theme (which has replaced "partnership"). He added, "Our standard for measuring worthwhile projects ought to be this practical question: What combination of efforts will do the most efficient job at the least cost to the American people? . . . It means a maximum national effort in which government at all levels and private enterprise work closely together."

Scale Models Help Designers

W. B. OTTO, Project Manager,
BRUCE PATON*, Design Supervisor, The Fluor Corp, Ltd, Los Angeles, Calif.



MODEL WAS MADE IN SECTIONS for easy shipping. The tapered cylinder on the far left represents the stack

BOILER MODEL helped designers locate platforming, then was airshipped to the boiler manufacturer

For the design of power plants, the cheap and simple device, the scale model, saves drafting time and helps the designer locate equipment and piping. It helps make a better plant and gives the utility's engineers and executives a visual aid for following design progress. And it cuts out bottlenecks for the supplying manufacturers.

The models shown here helped Fluor Corp, the designer, and Public Service of Colorado fit a 44-Mw steam unit into a space originally planned for 33 Mw at the Cameo plant near Grand Junction, Colo. No additional space was procurable—the Grand Valley Canal, the Denver & Rio Grande Western Railroad and a steep butte hem in the station.

The designer's model makers made several mockups of the proposed plant, including large-scale (¾ in. = 1 ft) ones of especially tight areas. One large-scale model, for instance, showed the area between the boiler and the turbine-generator, where the coal pulverizer and its input and output piping are sited. Here, where clearances were critical, the model helped the engineers locate equipment and piping with the most economical use of available space and without mutual interference. The model of the overall plant was on the scale of ⅜ in. = 1 ft. This is the optimum because it is large enough to show detail and small enough to ship.

Model Improves

When a plant like Cameo is designed, the models first come into the picture after heat balances, flow diagrams and site drawings are turned over to a layout designer, who teams up with the model makers. Teamwork is the key to profiting from models; the model makers become as much a part of engineering services as the draftsmen—and are on the scene ahead of them.

Working from the flow diagrams and other preliminary data, the layout designer develops several plant arrangements. The model makers translate the designer's two-dimensional scale models. Conferences with the client during this phase of the project usually produce quick approval of a definitive layout, partly because the model gives the customer such a clear picture of what he is buying.

With the major equipment arrangement approved, the model makers, working with structural and electrical engineers and guided by rough sketches, add auxiliary equipment, piping, valves and conduits. These help the designers spot their errors—such as

*Author Paton is now vice president and general manager of Atkins & Merrill, West, Inc, designers of industrial models.

and Builders

piping conflicts—and correct them then to avoid wasted drafting time later. Because no drawings other than flow diagrams and site layout have been completed, the drafting personnel have been at a minimum.

Only when the model is nearly complete do the draftsmen start construction drawings. The model is now an appreciable aid to them and to designers. It serves as a training aid for new designers. It shortens the drawing time and cuts down on revisions because the draftsmen can see in three dimensions what their drawings represent. The drafting time saved more than offsets model costs.

The model is a practical tool for getting the key project men together for making decisions—it has more lure than a set of drawings. These highly trained people find, too, that the model helps them convey complicated ideas to less-trained personnel both in the office and in the field.

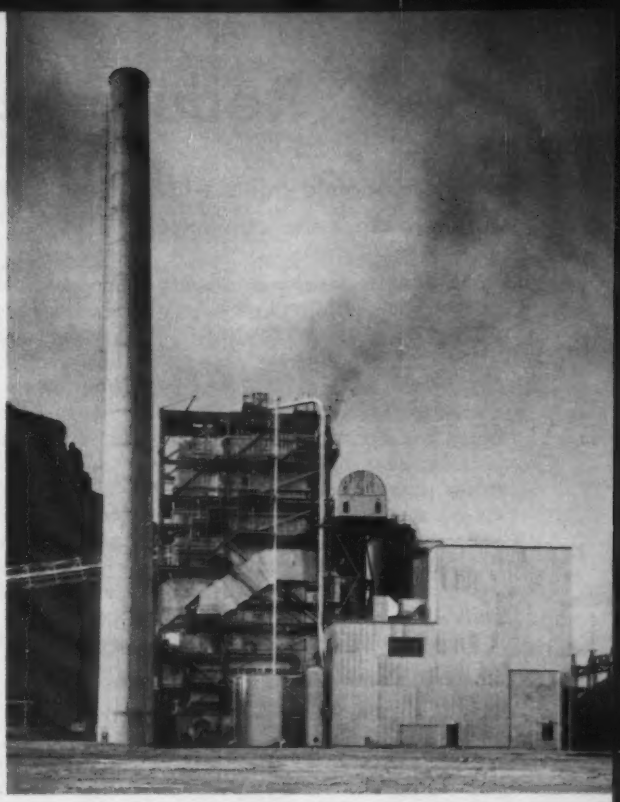
Aids in Field

When the time comes to start field work, enlarged photos of the model are sent to the construction men so they can get a good idea of the job ahead. The engineering department sends the model itself only after completing construction drawings.

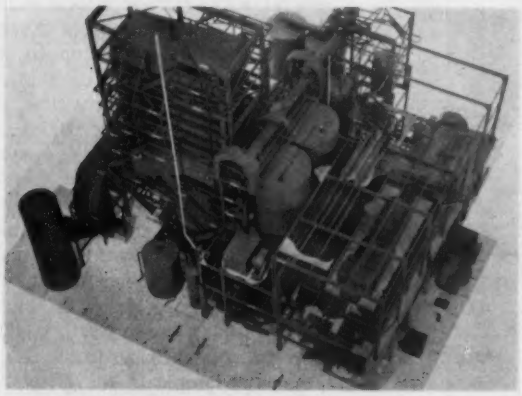
Many field superintendents make a practice of reviewing with the aid of the model the work to be done each day. The field forces can better picture the work with this visual aid in front of them. Because it also helps in deciding which trades are involved in the various construction areas, lost time from labor jurisdictional disputes is avoided.

Small-scale models also serve special purposes. The lower one on the opposite page is the Cameo plant boiler on the scale of ⅛ in. = 1 ft. The plant designers used it first in locating platforming to assure proper access. Then it was airshipped to the utility for approval and finally to the boiler builder to illustrate the designers' ideas on platforming.

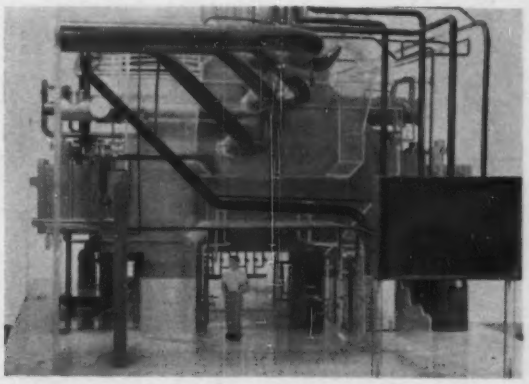
A ¾ in. = 1 ft scale model (below, right) of the turbine-pedestal area shows main steam extraction, oil and drain lines. Because it made unnecessary a tedious exchange of drawings between the designer and the turbine manufacturer, this model effected considerable savings.



SOUTH ELEVATION of the completed plant can be compared with the same view of model shown opposite



MAIN MODEL shows roofing cut away. Scale is ⅜ in. to 1 ft. This is also a view from the south side



TURBINE-PEDESTAL AREA model at twice scale of main model made the design of complex piping easier

Reduced-Loss-Ratio Transformer

Offers economic gains whose present worth during single load-growth cycle can exceed 10% of installation outlay

A. M. LOCKIE, Long-Range Development Engineer, Distribution Transformer Dept, Westinghouse Electric Corp, Sharon, Pa.

Distribution transformers with reduced loss ratio offer operating companies economic gains whose present worth during a single load-growth cycle can exceed 10% of the transformer's installed cost. Analysis of the role of loss ratio in the economics of operation indicates why this is so.

Loss ratio is defined as load (or "copper") loss at rated kva output divided by no-load (or "core") loss at rated voltage. In modern distribution transformers, this ratio ranges from about 3 to 1 to 4 to 1. Although losses in such transformers have been cut greatly over the years, the loss ratio has changed little.

Consider two transformers with equal total loss at rated load and selling at the same price, but with different loss ratios. Let the no-load and load losses in kw of one unit be Fe_1 and Cu_1, respectively, and those of the second unit Fe_2 and Cu_2.

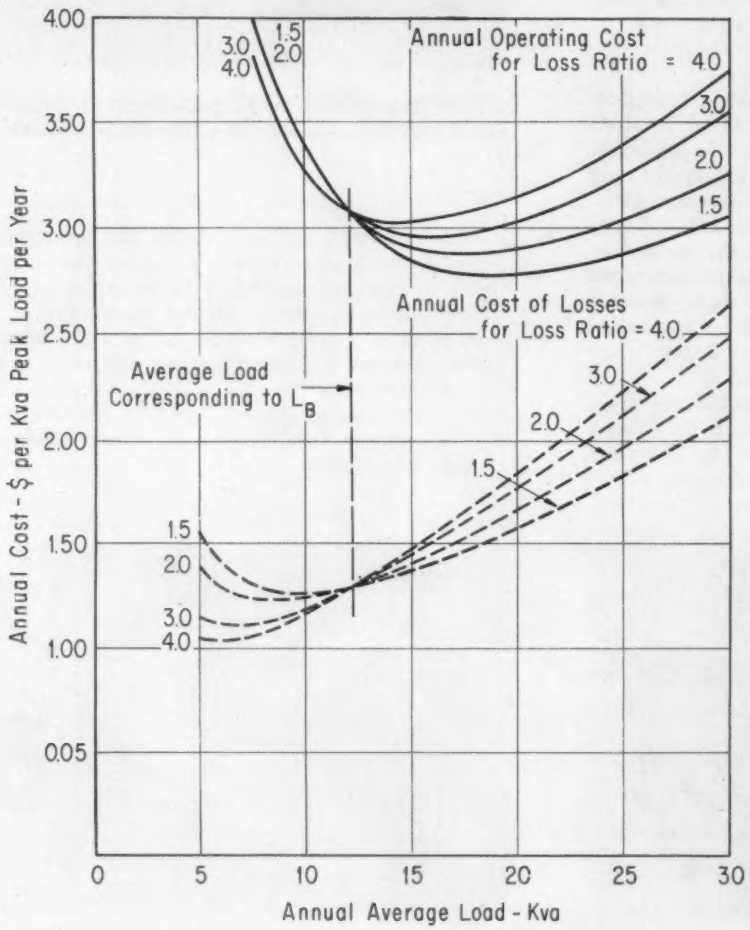


FIG 1—CHANGING THE LOSS RATIO of a typical 25-kva transformer affects both cost of losses and operating cost, when evaluated for typical parameters

Then the annual cost of operating each transformer on a load cycle with an annual peak of L times the transformer rating will be A_1 and A_2, where

$$A_1 = K_i + K_{Fe}Fe_1 + K_{Cu}Cu_1L^2$$

and

$$A_2 = K_i + K_{Fe}Fe_2 + K_{Cu}Cu_2L^2$$

where K_i = annual fixed charge on the installed cost of the transformer,

K_{Fe} = annual cost of 1 kw of no-load loss, and

K_{Cu} = annual cost of load loss when annual peak load loss = 1 kw.

Breakeven Load Found

The breakeven load, *i.e.*, the load at which the two transformers have equal operating costs, is found by setting $A_1 = A_2$ and solving for L. This load, designated L_B, is:

$$L_B = \sqrt{K_{Fe}/K_{Cu}}$$

The value of this load is independent of the specific losses or the loss ratios of the two transformers, K_{Fe} and K_{Cu} being determined by cost and load parameters only. In other words, when the two transformers sell for the same price, have the same total loss at rated load, and carry the same type of loading, there is one value of annual peak load at which the operating cost is the same for all loss ratios.

Thus, for all loads greater than L_B, the annual operating cost is cut when loss ratio is reduced. When peak load is less than L_B, annual cost is reduced by increasing the loss ratio. Another effect of loss ratio change occurs which does not lend itself to explicit analysis. But in general, a loss ratio reduction brings a reduced impedance which, in turn, decreases the voltage drop in the transformer. This raises the service-entrance voltage, thus providing additional utility revenue. The increased voltage also permits heavier transformer loading before the acceptable limit of voltage drop is reached. The exact effect of ratio change on voltage drop is determined by specific transformer design, although experience indicates that a rough proportion between voltage drop and copper loss is likely.

As an example of the effects of loss ratio reduction, consider a 25-kva transformer which has no-load loss (Fe) of 107 w and a load loss

Saves in Distribution Operation

(Cu) of 238 w, giving a loss ratio of 3.1 to 1. Compare it with a transformer of the same rating and price, but with losses of 145 and 290 w, or a ratio of 2 to 1. Assuming that the annual loss factor of the transformer load is 0.20, the demand charge for losses \$45 per kw, the energy charge \$0.005 per kwhr, and the transformer peak load coincident with system peak, then:

$K_{Fe} = \$45 + \$0.005 \times 8{,}760 = \$89$,

$K_{Cu} = \$45 + \$0.005 \times 8{,}760 \times 0.20 = \$54$, and

$L_B = \sqrt{K_{Fe}/K_{Cu}} = 1.28$

These calculations show that the unit having the new loss ratio is more economical whenever the annual peak load exceeds 128% of nameplate rating, the cost savings mounting with load. In fact, were this unit installed at an initial annual peak of 130% where load growth is 5% per year and allowed to remain there for years, present worth of accumulated savings (at 5%) would be more than \$20.

Cuts Voltage Drop

Furthermore, the change in loss ratio brings a reduction of voltage drop at rated load from 1.7 to 1.5%. With typical connected load, this increases energy consumption which, evaluated at \$0.01 per kwhr, raises revenue. Over the decade, the additional revenue would have a present worth of more than \$8. Thus the total economic gain comes to nearly \$40, with a present worth of more than \$28.

Transformers with reduced loss ratio bring definite economic gains to an operator only when (a) they are operated so that their annual peak load exceeds the breakeven load during most of their service life, and (b) they are obtainable at a cost comparable to that of conventional units.

The breakeven peak load cannot be less than nameplate rating unless the transformer load is virtually constant throughout the year. Consequently, when the load is highly variable, as is usually the case, the annual peak in the first year after installation should be at or above rated load. In the given example, the initial peak is 130% of nameplate rating and the ultimate peak about 200%. Deliberate loading to such levels is not common, yet the newly developed insulation systems, with demonstrated greatly improved thermal endurance, make it practicable.

That operating savings increase as the ratio, within limits, is reduced, presupposes that the transformer's installed cost is not increased. But reduction in loss ratio generally increases the weight of the core and coils. Thus there is a limit to the reduction in ratio practicable without a price increase. Indeed, it is very doubtful that the development and production of a new line of transformers, having substantially reduced loss ratio, could be justified without manufacturing economies.

As a practical means of attaining these objectives, distribution transformers are now available with a loss ratio of 2:1. Their temperature rise has been boosted to 65C at rated load to reduce the cost of cooling, a savings which is partially offset by the use of more copper so that total losses at the higher temperature are not increased. The reduced loss ratio, in combination with improved insulation, insures that these transformers will have a life expectancy at least equal to that of conventional designs.

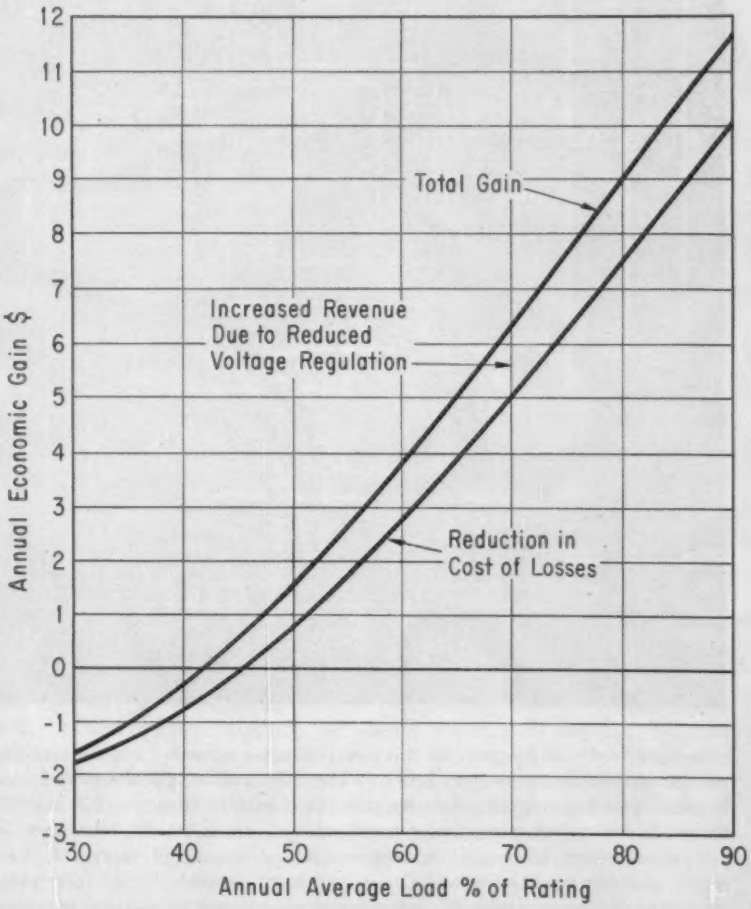
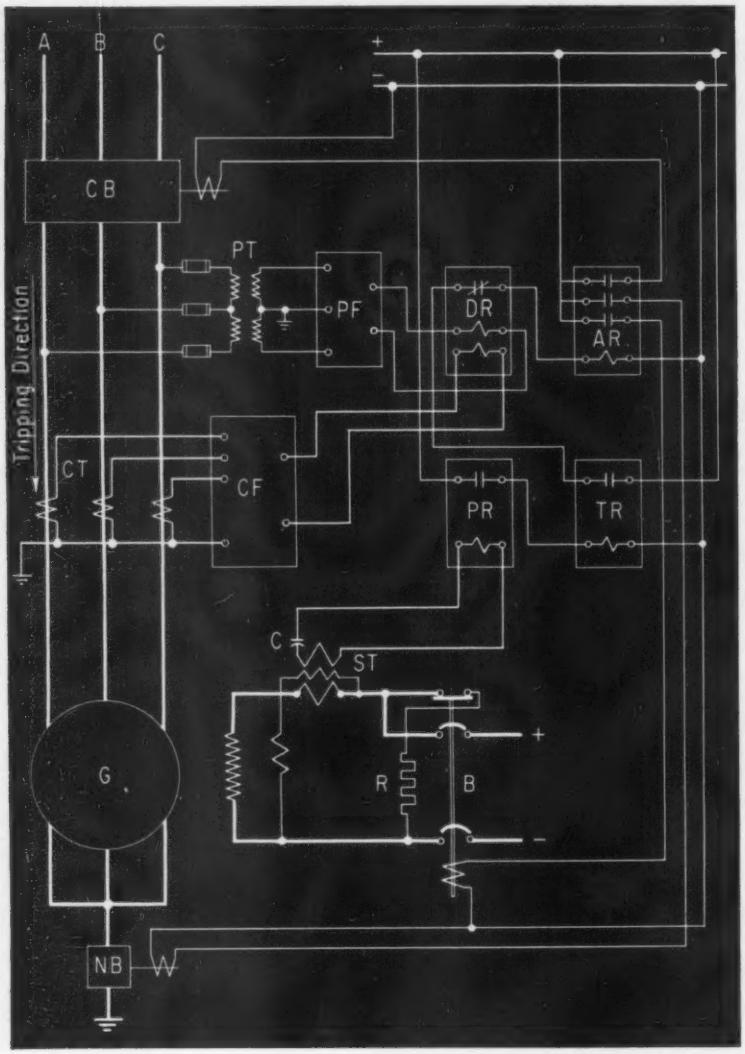


FIG 2—BENEFITS with present worth exceeding \$28 for a 10-year period can be obtained by cutting loss ratio of typical 25-kva transformer from 3.1:1 to 2:1

Relay Scheme Protects Generators

V. A. KINITSKY, Senior Electrical Engineer, Ebasco International Corp, New York, N. Y.

A new approach to protection of ac generators and other large sychronous equipment against internal faults lies in utilization of a fault-induced armature reaction on the field circuit as the primary indication of trouble. This protective relaying scheme, proposed by the author, could be applied to detect all internal faults, including open-circuited windings and short-circuited turns. The scheme is not limited exclusively to those large alternators with parallel-path windings and with nine leads brought out from the machine. Rather, it opens the way to full protection against internal faults for all synchronous machines, including those with only six leads brought out or with single-path windings.



In the connection diagram for this new protective scheme, G is the synchronous machine to be protected; B, the field circuit breaker; CB, the main circuit breaker; and NB, neutral circuit breaker. Devices in the relay circuit are ST, a special three-winding instrument transformer; C, capacitor; PR, instantaneous overcurrent relay; DR, negative sequence power directional relay; TR, time relay; and AR, auxiliary relay. Other equipment includes CT, current transformers in the main circuit; PT, potential transformers; CF, negative-sequence current-segregating filter; PF, negative-sequence voltage-segregating filters; and R, discharge resistance for the field winding

This scheme of protection makes use of the fact that during any unsymmetrical fault in the armature winding of a synchronous machine a negative-sequence current will flow through the defective winding path. This current will produce a second harmonic current in the field winding, which current can be detected by a field overcurrent relay. To guard against false tripping, the relay scheme would use a biased negative-sequence power directional relay to discriminate between internal faults and external faults or unsymmetrical load conditions.

Existing Method Is Limited

At the present time a combination of split-conductor (split-phase) and differential relay schemes is used to protect synchronous machines against all internal faults, including an open-circuited winding and short-circuited turns. But this method can be applied only to large alternators whose windings are connected in two or more parallel paths and with nine leads brought out from the machine. Synchronous machines having only six leads or single-path windings are not protected against turn-to-turn faults by this or other existing methods. A scheme of internal-fault protection suggested by Dr G. Calabrese (EW, May 21, 1938, p 76) has not been applied in practice, probably because of the possibility of false operation of the negative-sequence power directional relay as the result of a fault in the instrument transformer circuits.

The proposed method of protection, using the armature reaction on the field circuit, overcomes these limitations in protecting synchro-

Against All Internal Faults

nous machines against internal faults. Furthermore, the armature reaction on the field circuit produces a second-harmonic effect of sufficient current and voltage to serve as an effective means of detecting internal faults.

When a turn-to-turn fault occurs in the armature winding of a synchronous machine, a double-frequency current will flow in the field circuit. Magnitude of this current depends on the difference between the synchronous and the transient reactances of a single turn of the armature winding; the current flowing in the short-circuited turn; and the mutual inductance between the armature and field winding. The difference between the synchronous and transient reactances of a single turn usually is very small, but the current in the short-circuited turn can be ten times greater than rated current.

Therefore the magnitude of the second-harmonic current in the field winding is measurable. For salient-pole synchronous machines of conventional design without amortisseur windings in ratings from 250 kva to 75,000 kva, the double-frequency current in the field winding will range from 1.0 to 6.0 amp. For salient-pole synchronous machines with amortisseur windings, as well as for turbo-generators, the current will range from 0.1 to 0.6 amp.

Second-Harmonic Varies

The second-harmonic voltage at the field terminals will depend on the external reactance connected in the field circuit. Reactance of the armature windings of dc main exciters depends on load current and iron-path saturation; it can range from 0.003 to 0.015 h.

Thus the second-harmonic voltage at the field terminals of synchronous machines without amortisseurs can range from 2.0 to 68 v. For salient-pole synchronous machines with amortisseurs and for turbo-generators, the second-harmonic voltage can range from 0.2 to 0.7 v.

The double-frequency current is detected and fed into the operating coil of overcurrent relay PR by the special three-winding instrument transformer ST. The primary winding of ST is in series with the field winding of the machine. The secondary winding is tuned to double frequency through capacitor C to the operating coil of relay PR. The tertiary winding compensates for the saturation caused by the direct current flowing through the primary winding.

Eliminate Undesired Trip

A sudden change in the magnitude of dc field current during normal operation of the synchronous machine can produce a charging current through the capacitor higher than the pick-up current of relay PR and give an undesired trip. To eliminate this possibility, the normally-open contact of relay PR is in series with time relay TR. Time delay of relay TR should not be greater than 0.25 sec. Relay TR can be eliminated only if a suitable time element is incorporated into master relay PR.

External unsymmetrical faults also will cause a double-frequency current in the field winding, and thus an undesired operation of master relay PR. Selectivity for this condition is provided by negative-sequence power directional relay DR. Current and potential coils of relay DR are connected to the secondary leads of current transformers CT and potential transformers PT through the negative-sequence current-segregating filter CF and the negative-sequence voltage-segregating filter PF respectively. Primary circuits of the current and potential transformers are connected to the main leads of the machine.

The normally-closed contact of relay DR is in series with the normally-open contact of time relay TR to the coil of auxiliary relay AR. Normally-open contacts of the auxiliary relay are in series with the tripping coils of main circuit breaker CB, neutral circuit breaker NB, and field circuit breaker B. Time relay TR, auxiliary relay AR, and tripping coils are energized by an independent dc source.

Positive-sequence voltages only are generated in synchronous machines; a fictitious source of negative-sequence electromotive force is present at the point of fault. During external faults and unsymmetrical loads the negative-sequence power flows from the point of disturbance to the protected machine, i.e., in the tripping direction of relay DR. This relay will operate and open its contacts, thus preventing the operation of auxiliary relay AR to trip the unit.

During all unsymmetrical internal faults on the machine, such as turn-to-turn, phase-to-ground, phase-to-phase, double phase-to-ground, and open circuit, negative-sequence power flows from the machine to the bus, ie, opposite to the tripping direction of relay DR. This relay will not operate and thus auxiliary relay AR can trip all breakers and connect the field winding to discharge resistance R.

If simultaneous external and internal faults occur, the difference of negative-sequence power will flow through the circuit; operation of relay DR will depend on the direction of flow of this difference. If the difference of negative-sequence power flow is in the tripping direction, relay DR will prevent the tripping of the unit until the external fault is cleared. Then the contacts of relay DR will close and the faulted unit can be disconnected by the auxiliary relay AR.

Swinging Won't Cause Trip

Swinging and out-of-step operation will not produce tripping because a symmetrical load cannot produce a double-frequency current in the field. If asymmetry exists in the network during swings, the negative-sequence power directional relay will operate and prevent tripping of the machine.

Operating time of instantaneous relay PR may be set to 2-3 cycles on a 60-cycle base. Operating time of the negative-sequence power directional relay, together with the segregating filters, can be about 10 cycles. Therefore, for selective operation of this protection, a timing relay with a minimum 15-cycle time delay is necessary between relays PR and DR.

TABLE 1
DEIONISER 33-KV LINE TRIPPINGS

	Before Deionisers 1952	1953	1954	1955	4-Yr Avg	After Deionisers 1956	1957	1958	1959	4-Yr Avg
1. Trippings during lightning storms	3	5	5	10	5.8	1	7	3	8	4.8
2. Trippings at other times..										
a. due to deionisers...	0	0	0	0	0	3	2	1	0	1.5
b. due to other causes.	1	0	1	1	0.8	0	1	1	0	0.5
3. Total Trippings	4	5	6	11	6.5	4	10	5	8	6.8
4. Relative Lightning Severity†	1.8	2.3	1.6	3.2	2.3	0.5	4.9	0.9	3.6	2.3
5. Lightning Trippings per unit of Lightning Severity	1.7	2.2	3.1	3.1	2.5	2.0	1.4	3.3	2.2	2.1

TABLE 2
DEIONISER 33-KV LINE DAMAGE DURING LIGHTNING STORMS

Nature of Damage	Number of Locations with Damage Before Deionisers 1952	1953	1954	1955	After Deionisers 1956	1957	1958	1959	Average Number per Unit of Lightning Severity Before Deionisers	After Deionisers
Wire Burndown...	0	0	1	0	0	0	0	0	0.1	0
Insulator Burned..	1	1	6	1	0	4*	5**	3‡	1.0	1.3
Pole Splintered...	0	1	6	8	0	15	1	13	1.6	3.2
Relative Lightning Severity†.....	1.8	2.3	1.6	3.2	0.5	4.9	0.9	3.6	2.3	2.3

* Includes two pin-type deioniser locations with insulator damage.
** Includes three deioniser locations.
‡ Includes one deioniser location.
† Based on primary fuse blowings per 100 fuses in areas adjacent to but not under the 33-kv line during lightning storms.

TABLE 3
4-KV PRIMARY FUSE BLOWINGS DURING LIGHTNING STORMS IN VICINITY OF DEIONISER 33-KV LINE

	Before Deionisers 1952	1953	1954	1955	4-Yr Avg	After Deionisers 1956	1957	1958	1959	4-Yr Avg
1. Number of 4-Kv Fuse Blowings										
a. under 33-kv line...	2	5	0	16	5.8	1	1	1	6	2.3
b. not under 33-kv line	11	19	14	30	18.5	5	36	8	40	22.2
2. Total 4-Kv Fuse Locations										
a. under 33-kv line...	77	93	104	102	94	104	119	127	67	104
b. not under 33-kv line.	606	835	901	925	812	1000	773	928	1120	955
3. Fuse Blowings per 100 Fuses										
a. under 33-kv line...	2.6	5.4	0	15.7	6.2	1.0	0.9	0.8	0.9	2.2
b. not under 33-kv line	1.8	2.3	1.6	3.2	2.3	0.5	4.9	0.9	3.6	2.3

Experience

H. N. EKVALL, Senior Engineer, Philadelphia Electric Co, Philadelphia, Pa.

Operating experience over a four-year period indicates that the lightning protection provided by Cougnard Deionisers on 33-kv lines is not adequate for the Philadelphia Electric Co system. No further installations will be made.

Probably the most important reason why the deionisers failed to provide the necessary level of protection is the amplitude of short circuit currents involved. The available short circuit current on the lines tested ranges from about 3,000 to 8,000 amp at the various deioniser locations. Short circuit current is important because deionisers spark over during lightning storms, and the subsequent chance of a power arc forming and causing a line to trip increases with the magnitude of available short circuit current at the respective location.

Comparison Shows Effectiveness

Comparison of experience with the comparable four-year period immediately previous to the installation of deionisers reveals:

1. A reduction of 17% in the average number of 33-kv line trippings during lightning storms. Taking the relative lightning severity into account gives the same percent reduction for the four-year period but not for each year of the period.

2. An increase of 5% in the average number of 33-kv line trippings due to all causes including lightning. The reduction gained in trippings during lightning storms was largely wiped out by the increase in trippings during other periods because of the curiosity of squirrels, which caused deioniser flashover on five occasions.

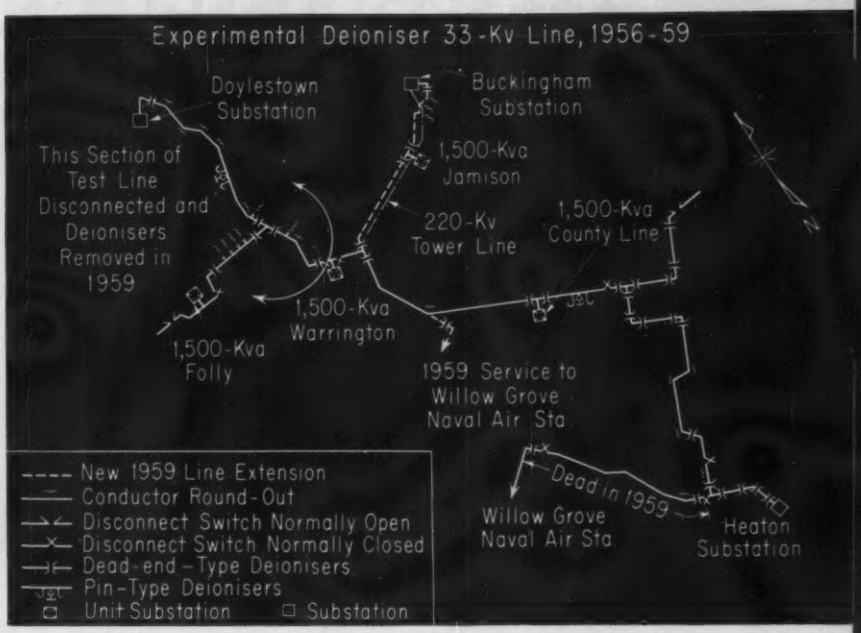
3. Line damage during lightning storms involved no wire burndowns although this trouble was not consequential before deioniser installation. There was a 30% increase in the number of locations with line insulator damage, half of these involving deioniser locations. The number of locations with pole splintering due to lightning almost doubled after installation of de-

Fails to Justify Deioniser Use

ionisers but this trouble was not serious.

4. Fuse blowings on 4-kv circuits during lightning storms decreased 65% directly under the 33-kv line after installation of deionisers, and the rate was about the same as that for other portions of the primary circuits not under the line.

The 17-mile Heaton-Doylestown 33-kv line on which the deionisers were placed is a 3-wire, 3-phase high-ridge-pin wood pole line, with two substation supply points at which its neutral is solidly grounded. In May, 1956, this line was equipped with 81 dead-end type deionisers and in August, 1956, with six pin type deionisers. The dead-end type were installed at right-angle bends along the line and the pin type at two locations on straight through sections. Round-outs were installed in lieu of deionisers where line angles ranged from just above 90 deg to 150 deg. These are auxiliary curved jumpers intended to aid the passage of ball lightning around a bend in the line.



Several Changes Made

During the four-year period the line was subject to several changes. The number of dead-end units remained the same in 1957 but increased to 87 units in 1958 and decreased to 69 units in 1959. These changes were necessitated by line rearrangements to handle changes in load. The pin type units were removed in July, 1957 after their insulators were badly damaged during lightning flashovers at both installations. These units were found to have inadequate clearance between their upper and lower "U" plates.

The clearance between plates of the dead-end type units remained at 9½ in. for all installations during the entire period. This spacing gave an impulse sparkover strength of about 200 kv, whereas the normal impulse strength of the line is about 700 kv.

During the first two lightning seasons all deionisers were grounded to the common primary-secondary neutral wire and also to a 10-ft ground rod at each location. This procedure gave a low ground resistance of about 2 ohms, mainly due to the multi-grounded neutral. With this low value of ground resistance, the single-phase-to-ground short circuit currents at deionisers ranged from 3,000 to 8,000 amp, which was enough to cause line tripping.

During the past two lightning seasons experience was obtained with relatively high resistance grounding. This was done by disconnecting the deionisers from the common neutral wire and leaving their grounding solely to the ground rods which had ground resistance values ranging from 16 to 280 ohms. These grounds limited the deioniser single-phase short circuit current to values below the 360-amp minimum required to initiate line tripping.

Thus the use of high-resistance grounds helped to improve line performance by preventing some line trippings due to single-phase flashovers. However, these high resistance grounds were of no benefit in limiting short circuit currents or preventing trippings due to flashovers on two or three phases.

Dead-end type deionisers have shown the following interesting characteristics:

1. They have performed more frequently as "gaps" by sparking over during lightning storms than as barriers to ball lightning, which phenomenon is still a mystery.

2. During the experimental period, 65 deionisers experienced power arc burns on their plates following lightning discharges. Many of these were not accompanied by line tripping. Action of the wind and high ground resistance to single-phase flashovers may explain why some of the power arcs did not cause line trippings.

3. There were numerous bright spots on the deioniser plates, evidently due to lightning discharges which did not result in power arcs. Also, over 400 black marks were observed after lightning storms. These were generally near the edge of the plates. Their cause has not been determined, but their origin may have been associated with high voltage stress between the plates.

4. Extensive discharge activity on the deionisers was largely due to their low-impulse sparkover of only 200 kv, which made them weak spots in the line compared to the other poles which had an impulse strength of about 700 kv.

Clinometer Saves Pole Climb

The aid of a clinometer in determining the height of a pole-mounted transformer eliminates the need for climbing the pole, and otherwise saves considerable time when establishing the length of conduit required to run from transformer down through underground service to multiple housing units.

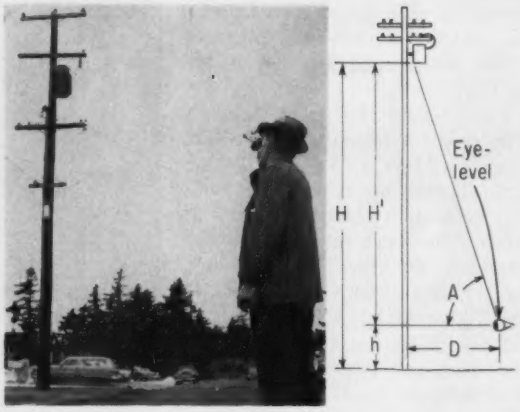
The clinometer is a device incorporating an adjustable-angle sighting arm, referenced against a bubble sight level. The simplest method for determining the height of the transformer with the clinometer is as follows:

(1) Set the clinometer to 45 deg. Sighting through the eye piece toward the pole, back away until the bubble of the sight level and the bottom of the transformer appear together. Then, standing in the same sighting position, reset the clinometer to zero. With the bubble of the sight level centered, sight the pole through the eye piece and note the spot on the pole in coincidence with the level bubble—this spot necessarily is level with the eye.

(2) Measure: the distance (D) from the sighting position to the pole; and, the distance (h) from the determined eye-level spot on the pole to the ground. The height (H) of the transformer is:

$$H = D + h$$

Actually, any angle can be used to determine transformer height with the clinometer. With an angle other than 45 deg the height (H) of the transformer is calculated by trigonometry. Example: Walk off a known distance from the pole. Sighting through the clinometer toward the pole, move the adjustable arm until the bottom of the transformer and the



bubble of the sight level are both brought into the viewer. Read the angular position of the sighting arm. Reset clinometer to zero. As in (1) above establish the eye-level spot on the pole. The height (H) of the transformer is then calculated by

$$H = H' + h = (D \times \text{tangent A}) + h$$

as identified in the accompanying line sketch. For example, if one has walked off 50 ft from the pole, then noted a 60 deg achieved angular position on the clinometer and finally measured the eye-level spot on the pole as 6 ft from the ground, the transformer height (H) is:

$$H = (D \times \text{tangent } 60) + h$$
$$= (50 \times 0.577) + 6 = 34.9 \text{ ft}$$

Guard Eliminates Pneumatic Drilling Hazards

I. H. **FREY**, General Supt of Transmission and Distribution, Buffalo Area, Niagara Mohawk Power Corp, Buffalo, N. Y.

A simple, inexpensive metal guard developed by Niagara Mohawk permits crews working near vaults to strip concrete, and even conduit, from energized conductors without hazard to the cable or the workmen. Made of semi-circular, stainless steel airplane tubing, the guard is slipped between the cable and the conduit from the open, or vault, end of the duct. The concrete can then be cut away with a pneumatic air hammer.

Light in weight but very tough, the guard can take 15 blows from a chisel bit without puncturing. The guard was developed because of difficulty experienced in attaching an adequate ground to the air hammer. The guards are made in 1, 2 and 3-ft lengths, with and without handles.

(*More Methods on page* 50)

PREFERRED LIGHTING...

8 reasons why you get more light per dollar

General Electric *PREFERRED LIGHTING* is based on a simplified line of outdoor-lighting products which actual purchases show most customers prefer. Here are 8 ways *PREFERRED LIGHTING* adds up to more light per dollar on your streets and highways:

- A full selection of modern, fast-moving equipment.
- One- to four-day delivery on complete lighting systems.
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For full data on *PREFERRED LIGHTING*, see your G-E Apparatus Sales Engineer or Agent now. And write to General Electric Co., Section 460-09, Schenectady, N. Y. for the 28-page "Designer's and Buyer's Guide to *PREFERRED LIGHTING*" (GEA-7100). Outdoor Lighting Dept., Hendersonville, N. C.

General Electric's famous "Crossroads of Light," Hendersonville, N. C., lighting demonstration area for your use.

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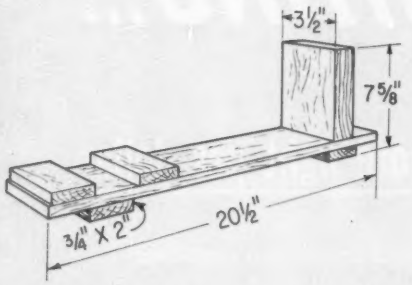


Wooden Frame Supports Breaker Barrier

CLEM S. HEATER, Substation Mechanic "A," Indiana & Michigan Electric Co, South Bend, Ind.

Wooden frames simply and safely support the barrier of many types of circuit breakers to allow quick inspection and cleaning of electrical parts. The frames eliminate manual handling of the heavy barrier, and thus reduce fatigue and prevent possible injuries due to strain. Furthermore, these frames allow the exposed circuit breaker to be thoroughly cleaned if necessary. (See also, oil-flush cleaning of a breaker, EW, Dec. 28, 1959, p 87.)

Three wooden frames were constructed to support the barrier atop the tank. These are used to lower the insulating barrier for the visual inspection and cleaning. Steps in the procedure for handling the barrier are:

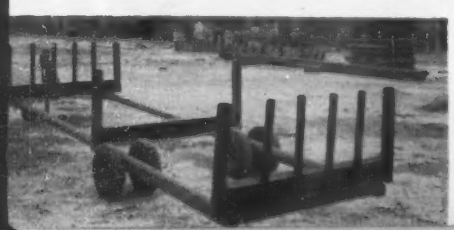
1. Lower the OCB tank, using tank lifters.
2. Remove all stationary contacts and the bushings on one side of the breaker. Disconnect the operating rod.
3. Place the three wooden frames in appropriate positions atop tank. Then raise tank until frames are snug against top barrier.
4. Remove bolts holding top barrier to cover.
5. Lower the tank with barrier resting on frames.

Some sideward movement may be necessary when lowering the tank to clear the remaining three bushings. Also, because each side of the tank is handled by a separate lifter it is important to lower both sides of the tank at the same time.

Ingenuity Pays Off in Job Practices

"Ingenuity" is the brand of the thinking man—whether or not he smokes the right brand of cigarettes. A number of men at Detroit Edison Co are practical evidence of this observation, and they are the richer for it.

Recently, Detroit Edison presented financial awards to certain men who had by their "on-the-job thinking," improved company routines involving equipment testing, materials handling, and safety. Each of the suggested methods are quite simple, yet each reflects a "thinking attitude." Three "new ways" in use are here presented as suggested by the originators.



Equipment Testing—Edward G. Mehney, Production Dept: "Use a slightly higher-than-normal nitrogen pressure to locate leaks on nitrogen-capped transformers at Conners Creek Station. With a pressure of 5 psi, a leak becomes audible, thereby minimizing both the time spent looking for leaks and the time during which gas is being wasted."

Materials Handling — Michael Nedaliz and George Ziemba, Stores Dept: "Separate, according to shipping destination and/or size, pipe being moved on pipe hauling trailers, from the Warren Service Center to truck loading points. Pipe separation can be achieved by using removable vertical posts of 1½-in. pipe, 2½-in. long, on the front and rear of the pipe hauling trailers. The separating posts can save many hours of pipe handling time and thereby avoid delaying the departure of trucks."

Safety—Lino Olivotti, Construction and Maintenance Dept: "Use an oversized link attached to the end of load chains on chainfalls to prevent the load from falling in case a worn pin breaks or because of improper operation of the chainfalls. This link, called the Hammer-Lok, is too large to go through the chain passage in the gear case—thus, the load cannot fall."

CONTAMINATION SEALED OUT, RELIABILITY SEALED IN

You can reduce power outages, maintenance costs and service complaints on your distribution system because of a special seal on General Electric's Type HR automatic reclosers.

A Nitrile rubber gasket seated in the tank and a three-way clamp provide a constant seal around the entire top of the tank of the G-E recloser. Moisture and impurities are sealed out. Long, trouble-free service life is sealed in.

For further protection against contamination bushings are gasketed and clamped in place, and the shaft of the operating handle is surrounded by a one-way seal which lets interrupting gas escape, but prevents the entrance of moisture.

OTHER BENEFITS

In addition to protection against contamination, G-E reclosers are:

- **Easier to adjust.** Pin-and-wheel timing controls permit quick selection of operating sequences.
- **Designed for longer operating life.** Rolling contacts break quickly with a minimum of wear.
- **Protected by a three-year warranty on materials and workmanship.** As a result, you're assured of superior recloser performance when you buy from General Electric.

General Electric hydraulic reclosers (5 to 280 amps) can be used with or to replace other types of reclosers you now may have on your distribution system.

Ask your General Electric Sales Engineer for more information on how G-E reclosers can provide your distribution system with flexible, trouble-free protection against outages caused by temporary or transient short circuits. Or send to Section 493-01, General Electric Company, Schenectady 5, N. Y., for Bulletin GEA-7023.

Progress Is Our Most Important Product

GENERAL ELECTRIC

Sag Template Solves

C. F. NIETER, Senior Distribution Engineer, Indiana & Michigan Electric Co, South Bend, Ind.

A graphic short cut solves various types of conductor clearance problems at a saving of considerable time to distribution engineers. This method uses a single sag template of any convenient size available.

The horizontal and vertical scales used in making the profile are varied to make the problem fit this sag template instead of constructing special catenary curve templates to fit the particular problem. Formerly, we made an estimate and provided a generous allowance in pole height, constructed special templates, or used a time-consuming mathematical solution.

Method Has Many Uses

This method can be used to determine vertical clearance between overhead lines and railroads, telephone lines, buildings and equipment. It is helpful in finding the exact pole height needed to clear one or several points in a span, pole heights needed to avoid uplift on intermediate poles, or for determining conductor heights at any point between poles.

The convenient scales on the standard engineer's scale or ruler are used to fit the size sag template available. The vertical scale is selected so that the distance from the bottom of the sag to the highest point will be slightly less than the height of the template.

When the appropriate sag height is measured off according to this vertical scale, the horizontal dimension that the span length must fit to is determined. However, a standard scale will not match this exactly, so the nearest standard is selected and the ruler slanted until the correct distance on the scale matches the horizontal dimension. The critical points are projected from this slant line to the horizontal.

Any size catenary curve sag template may be used. However, one with a large amount of sag will give better results because it will permit using a larger vertical scale that gives greater accuracy and is more easily read. As the same template can be used for solving all types of conductor clearance problems, it is worth while to make a special catenary curve template for this purpose.

Example

Assume that minimum pole heights required to clear several railroad tracks and a communication line running below must be determined. The elevations of these points and their locations along the center line and the required conductor clearances above them are known.

As shown at the bottom of the drawing, the span length is 222 ft. This gives 3.4 ft of final sag for No. 1/0 bare copper conductor at 60F. Ground elevations are 96.7 ft at the point where pole "X" will be and 92.4 ft at pole "Y." The difference in elevation is 4.3 ft. Add this to the 3.4 ft of sag to get a total possible change in elevation along the conductor of 7.7 ft. With this information, solve the problem graphically, as follows:

1. Draw the full catenary curve by tracing the template, identified as line (1).

2. Draw a vertical line through the low point on this curve; line (2).

3. Find the largest convenient scale that will measure the 7.7 ft change in elevation along line (2) between bottom of curve and highest point. In this case 1 in. = 2 ft is appropriate. This assures that the scale (and the template) will encompass this particular problem.

4. Scale the amount of sag (3.4 ft in this case) on line (2) from bottom of curve, using the 1 in. = 2 ft scale. Draw horizontal line (3) through this point.

5. Draw vertical lines (4) and (5) through the two points of intersection of line (3) with sag curve

Working Table

(All distances in ft)

Location Along Span	Elevation	Required Clearance	Minimum Conductor Elevation
x	96.7	....	?
A	99.5 } railroad tracks	28.7	128.2 (A′)
B	98.1 } railroad tracks	28.7	126.8 (B′)
C	98.5 } railroad tracks	28.0	126.5 (C′)
D	122.0 signal wire	4.4	126.4 (D′)
y	92.4		?

Clearance Problems

(1). The distance between (4) and (5) is now the span length of 222 ft at a scale still to be found.

6. Try various scales that will show 222 ft between lines (4) and (5) at a slant line, but as near to a horizontal line as possible. In this case, a scale of 1 in. = 60 ft is most appropriate. See line (6).

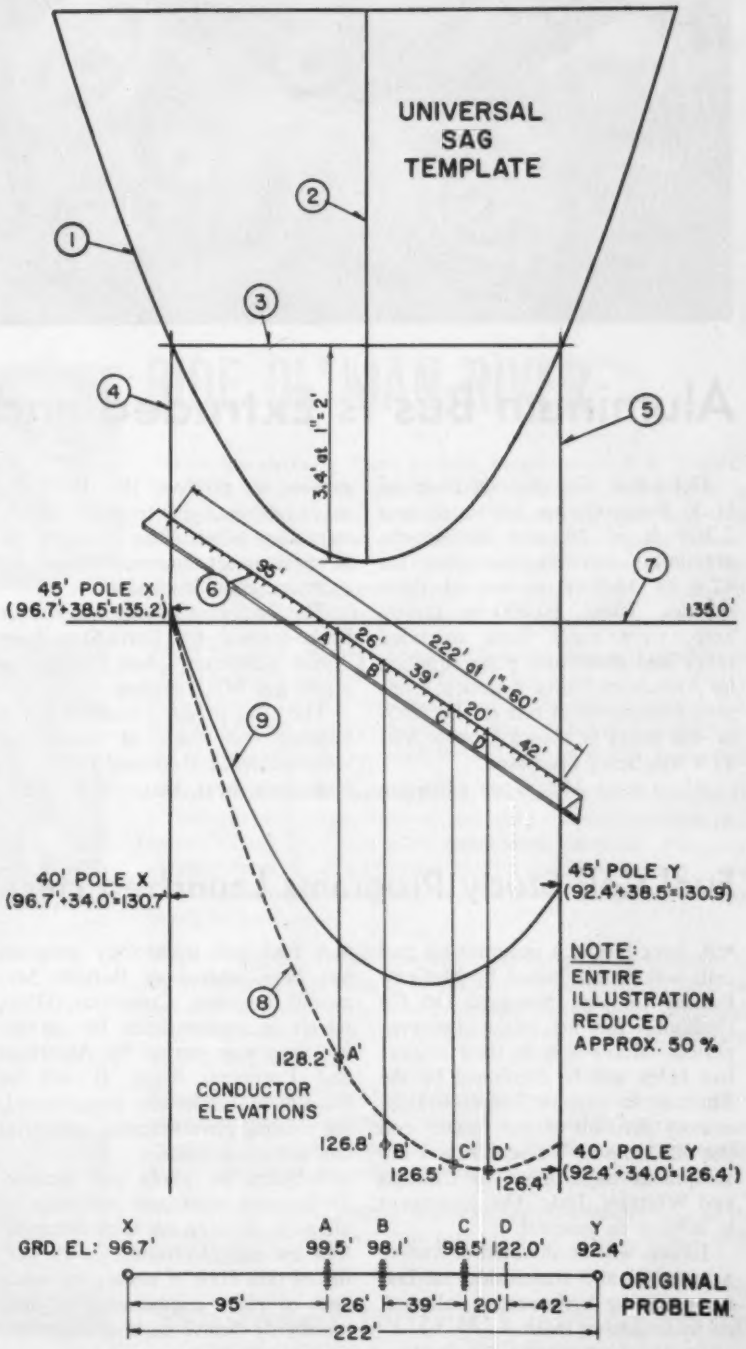
7. Scale the crossing points A, B, C, and D on this line at 1 in. = 60 ft. and draw vertical lines through these points.

8. Set up a table to show elevations and clearance requirements (for 12 kv) at conductor crossing points and pole locations. (See table.)

9. To establish a base line for measuring, draw a horizontal line (7) at a convenient elevation for reference, say 135 ft. Then, from this base line and on the vertical lines previously drawn through points A, B, C and D, spot points representing the minimum conductor elevations as shown in the table: 128.2 ft at A, 126.8 ft at B, 126.5 ft at C, and 126.4 ft at D.

10. With template aligned vertically, draw preliminary sag curve (8) as a dashed line intersecting as many as possible of the critical clearance points while staying above the others.

11. On lines (4) and (5) mark the conductor positions for the nearest standard pole heights that will provide adequate clearance. (Here, conductor elevation and pole top were assumed to be the same.) In this example a 45-ft pole was needed at "x." Since a 40-ft pole would be slightly short at "y," a 45-ft pole was selected here too. The resulting sag curve can then be drawn, as shown by solid line (9).



Aluminum Bus Is Extruded and Brake-Formed

Delta-Star Electric Division of H. K. Porter Co has fabricated over 2,300 ft of 19 and 20.5-in.-dia aluminum isolated-phase bus for 12.6 to 16.5-kv service of three utilities. Units, 10,000 to 11,500 amp, were made from extruded tubes and aluminum plate supplied by Aluminum Co of America. Contorted assembly of one of the 20.5-in.-dia buses is shown (above, left) as it was being processed.

Alcoa used 14,000-ton extrusion presses to produce the 19-in.-dia tubes (above, right) from EC aluminum alloy billets. The company believes these set the record in size for extruded tubular conductor.

The 20.5-in.-dia tube was roll or brake-formed by Delta-Star from Alcoa aluminum plate, joined by argon gas MIG welding.

The 42-in.-dia isolated-phase housing was made of continuous seam-welded, roll-formed 1100 alloy aluminum sheet, ⅛ or ¼ in. thick, supported by cast aluminum ring supports. This all-aluminum combination of housing and ring supports provides continuous ground for the bus.

Buses, of "telescoping" design, have flexible leads for joints, permitting movement at these points. These leads are flexed laminations of 40 aluminum sheets welded to aluminum plate at each end. With exception of insulating supports, bus is virtually all-aluminum.

Fuel Cell Study Programs Launched Here and Abroad

• A joint research program on fuel cells will be conducted by McGraw Edison Co and Standard Oil Co (Indiana) for an initial two-year period. Know-how in their respective fields will be combined by the Thomas A. Edison Research Laboratory division of the former and the oil company's research and development department in Chicago and Whitting, Ind. The agreement is subject to renewal.

Efforts will be directed at finding a practical and economical method for oxidizing hydrocarbon, alcohol, or hydrogen as fuel.

• A fuel cell technology program has been started at Battelle Memorial Institute, Columbus, Ohio, which is underwritten for an initial five-year period by American and European firms. It will be fundamental in nature, complementing existing governmental, industrial and academic studies.

Subjects for study will include: 1) Internal electronic structure of alloys to develop an alloy composition for cell electrodes; 2) Properties of thin films of metals for selection of right combination of materials; 3) Active carbon electrodes with metal-chelate surfaces; and 4) Use of unusual plating techniques to apply porous metal surfaces to electroformed electrodes for the cell.

• The Shell Petroleum Research Center at Thornton, Chesire, England, has produced a "radically new" type of fuel cell, with its electrode design a closely-guarded secret. The center says it beats rival cells of comparable size in power output. It is a low-temperature unit which can start at 25C, uses hydrogen as fuel.

(*More News of Manufacturers, p* 56)

WAGNER TRANSFORMERS

RIDE OL' MAN RIVER

Out in the channel, that's Federal Barge Lines' M.V. UNITED STATES. Designed and built by St. Louis Shipbuilding & Steel Co., she's the most powerful towboat on America's inland waterways. Headed up the Mississippi, this 8,500 horsepower giant pushes a record-breaking 42 barges, the equivalent of seven and one half acres. The boat is designed to push 40,000 tons of cargo, the capacity of a freight train 1,000 cars long.

You'll find seven Wagner Dry-Type General Purpose Transformers on duty aboard the UNITED STATES. Six 10 Kva and one 7½ Kva transformers (all 480 volt primary, 120/240 volt secondary, with 2 extra primary taps) are used to power this muscled lady's lighting system, small motors, and most of her navigation equipment.

Ashore or afloat, Wagner Type AE Transformers can be used for all general purpose applications, including those where noise must be minimized. They have a low sound level, the result of encasing smaller Form W core and coils in solid epoxy compound... give you a whisper-quiet transformer that can be used anywhere noise would be a nuisance.

Wagner Type AE Transformers have insulation protection suitable for continuous operation at 80°C in a 40°C ambient. All parts are sealed from dust, moisture, and corrosion by the epoxy compound. Naturally, every unit is built to conform to all applicable standards of ASA and NEMA.

Wagner Type AE Transformers can be installed indoors or out... anywhere they will not be submerged or exposed to injurious fumes in concentration. Compact and lightweight, they can be mounted in any position at any angle, on walls, floors, or ceilings.

Like to know more? Wagner branches and distributors have all the details. There's one near you, listed in your 'phone book. Call or write. Soon.

WT60-13

Wagner Electric Corporation

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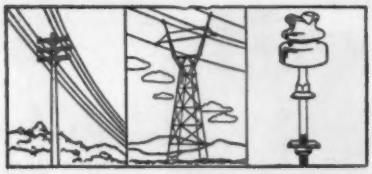

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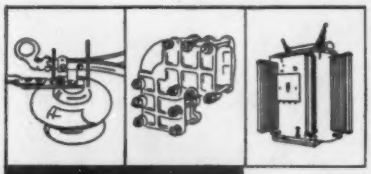
on all bolted assemblies



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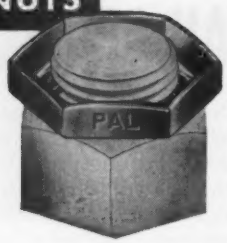

PALNUT Lock Nuts apply so fast, lock so dependably . . . you can specify them for every nut-and-bolt assembly, at negligible cost. Maintenance is reduced on mechanical assemblies—full conductivity assured on electrical connections.

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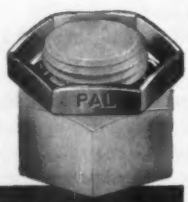

PALNUT
TRADE MARK
LOCK NUTS
for quick, secure fastening at low cost

MANUFACTURERS BRIEFS

Ohio Brass Co will buy all assets of Timpte Bros, Inc, manufacturer of trailers and truck bodies, and will operate it under direction of Holan Corp. J. Howard Holan is vice president of OB. Cash involved was not disclosed. Part of new facilities being built in Denver will be used for making Holan equipment. Further expansion is planned for the western area to provide wider base for both Holan and Timpte products in assembly, sales and service operations.

Steele Manufacturing Co, new pole line hardware manufacturer, has begun operations. Firm is now making arc-proof connectors; 40 types will ultimately be produced. Thirty-one other items used on electric power lines will be made when the new Tyler, Texas, plant is completed.

Basic Product Crop reports record sales and increased earnings for its fiscal year, which ended July 31. Net sales of $53.7 million compare with $45.7 million for 1959; net earnings of $2.4 million with $2.0 million last year.

Barkelew Electric Mfg Co is touring coast-to-coast with an exhibit of its Bolt-Loc load break service entrance switch. It is being shown to utilities, steel mills, chemical plants, consulting engineerings, architects, and electrical equipment distributors. Switch comes in 1,200 through 4,000 amp for 240, 480 and 600-v service.

General Electric Co, anticipating a 33% increase in the computer market within two years, has decided to step up its participation in the industry by that time. Its computer department, now with two data-processing centers and 16 sales offices, will have 11 additional centers and 10 more sales offices extending across the United States.

American Brass Co, wholly owned subsidiary of The Anaconda Co and manufacturer of copper and brass mill products, has changed its name to Anaconda American Brass Co.

ASEA, Swedish electrical manufacturer, has been awarded a $1.2-million contract by the US Army Corps of Engineers for 10 main transformers for the DAHE Reservoir Project on the Missouri River. Contract covers one 103-Mva, 3-phase transformer and nine 68,667-kva, single-phase transformers and spare parts.

General Electric Japan Ltd has been awarded contract to construct 12,500-kw demonstration nuclear power plant for the Japan Atomic Energy Research Institute. General Electric Co's atomic power equipment department will design and supply nuclear part of the plant.

MANUFACTURERS LITERATURE

THERMOCOUPLE WIRE . . . bare and insulated, also extension wire: insulated and multiple conductor extension cable. List prices and ordering directions tabulated. Catalog G100-2, 14 pages. Minneapolis-Honeywell Regulator Co, Wayne & Windrim Aves, Philadelphia 44, Pa.

POWER SWITCHING EQUIPMENT . . . standards publication includes rating, performance, testing and application of such equipment. Supersedes Publication No. SG6-1954. Sections on definitions, air switches, interrupter switches, insulators, accessories, outdoor stations, also instructions for installation, operation, and care of power switching equipment. Pub. No. SG6-1960, $3.00, 60 pages. National Electrical Manufacturers Assn, 155 East 44 St, N.Y.C.

BUS DUCT . . . for plug-in, low-impedance, high-frequency and electric-utility bus duct. Drawings and descriptions illustrate variety of applications for four types of bus duct to meet needs of secondary power distribution systems. Application data No. 30-660, 12 pages. Westinghouse Electric Corp, Box 2099, Pittsburgh 30, Pa.

Pre-Engineering by **KAISER ENGINEERS** answers basic plant expansion questions...

Raw Materials?

Your final decision to expand or build results from a series of important individual decisions. Raw material availability is one of them. Independent analysis of all aspects of your proposed program is the *Pre-Engineering* service offered by Kaiser Engineers. In addition, KE designs and builds all types of power plants—steam-electric, gas turbine, combined cycle, nuclear and hydro-electric. Whatever your requirements . . . from Pre-Engineering analyses through plant design and construction . . . Kaiser Engineers brings world-wide experience and ingenuity to their solution.

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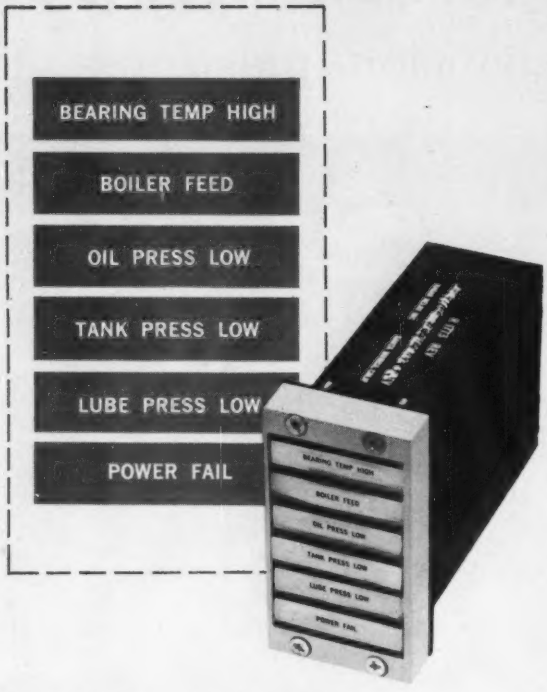
6231-P



SOLID STATE
miniaturized
ANNUNCIATORS *for*
at-a-glance information

Radar Relay offers an outstanding development in Visual Communication Systems. One-third the size of current units, Radar Relay annunciators, now with solid state circuitry, can do a variety of jobs. For instance, for utility applications, they can display conditions such as bearing temperatures, boiler feed and oil flow status. Radar Relay specializes in providing at-a-glance information—from eye-to-brain—to safeguard as well as control vital processes.

If you have a problem that can benefit from advanced Visual Communication systems, write us today.

RADAR RELAY INC.

2322 Michigan Avenue, Santa Monica, California
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AEC to License Research For Utility Thorium Reactor

The Atomic Energy Commission has given a notice of intent to issue an operating license to Atomics International for a critical experiments facility at its field test area in Ventura County, Calif.

The division of North American Aviation, Inc, will use the facility to gain experimental data for the epithermal thorium reactor it is developing for Southwest Atomic Energy Associates, a group of southern and southwestern investor-owned utilities.

The Hazards Evaluation Branch of AEC's Division of Licensing and Regulation reported reasonable assurance that the facility can be operated without undue hazard to public health and safety. AEC representatives will decide if it meets the construction permit.

Meanwhile, Atomics International has started up AEC's Sodium Reactor Experiment with a second core of thorium-uranium alloy. The first produced 15,300,000 kwhr in about two years before clogged coolant passages caused a cladding failure.

The Sept. 5 start-up was the first time the reactor has been operated since July 26, 1959, when parted fuel elements were observed.

Hurricane Damage Light

The Mobile Division of Alabama Power Co sustained "very little damage" recently when Hurricane Ethel came to town. Division Manager E. A. Benson estimated damage at "not over $4,000 to $5,000."

"Over an eight-hour period," Benson said, "eight distribution feeders were knocked out and in trouble. There were some service interruptions but none occurred for more than several hours."

The division's crews handled all of the approximately 2,000 service calls received. At one point, four Alabama Power crews comprising about 100 men started from upstate, but were recalled when the division reported it did not need them.

Ethel arrived in Mobile early Sept. 15, but the winds in the area never exceeded 50 mph. No transmission trouble was reported.

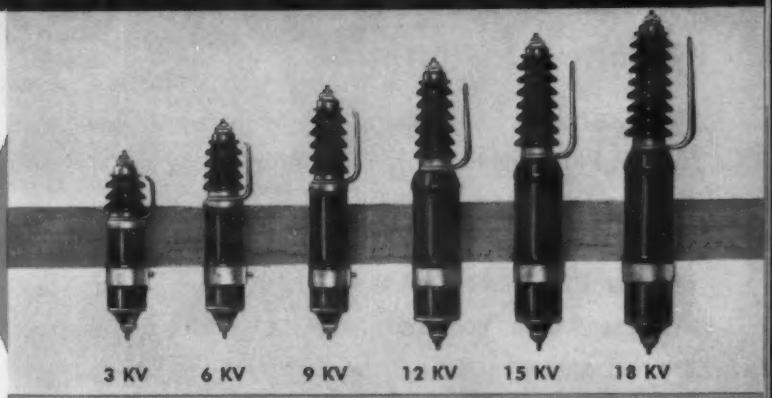
THE JOSLYN FAMILY

of distribution lightning arresters

gives you a choice

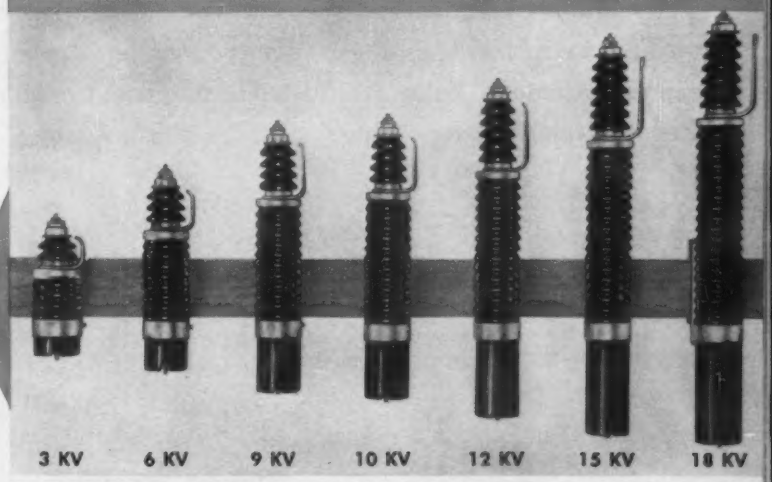
EXPULSION

The right arrester for the job where frequent and severe lightning occurs, but where system short-circuit currents are moderate. The ideal arrester for rural areas.

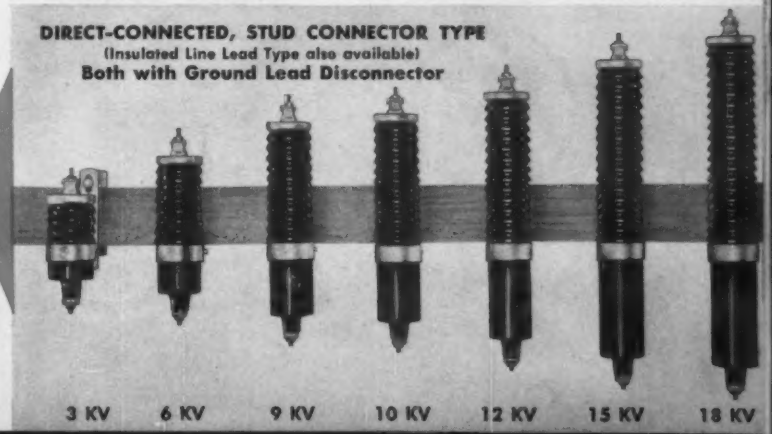


VALVE

The arrester to use where high system short-circuit currents exceed expulsion arrester capacity, but where less severe lightning currents occur. The ideal arrester for dense urban areas.



DIRECT-CONNECTED, STUD CONNECTOR TYPE
(Insulated Line Lead Type also available)
Both with Ground Lead Disconnector



Choose the Right one for Your particular needs...

JOSLYN COMPLETE POLE LINE EQUIPMENT ®

JOSLYN MFG. AND SUPPLY CO.
155 North Wacker Drive • Chicago 6, Illinois

new PR recloser timing mechanism key to complete system coordination

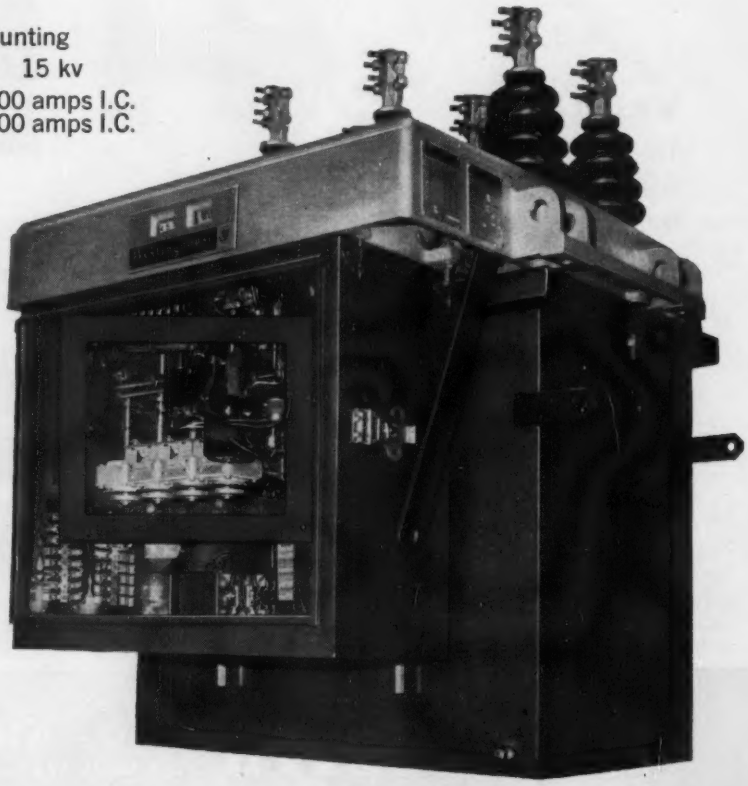
A new sealed pneumatic-spring timing mechanism with the industry's widest range of adjustability is the key to complete coordination of your distribution system's protection. Here's how this accurate and easily calibrated mechanism solves the problem. PROBLEM: To secure complete operation coordination of substation protective device with high side fuse or relay, thermal ability of the transformer, and distribution reclosers or fuses. SOLUTION: Plot time current curves of high and low side protective elements—then draw in a curve that coordinates with these. Then simply calibrate the PR recloser to match this curve—or specify it with the PR. ■ Whether it is a fuse link, CO relay or hydraulic recloser you are matching, the PR recloser can be adjusted to give complete coordination. ■ All control components are clearly identified, and permanently attached instructions make adjustments easy. Indexed, knurled knobs on the pneumatic timers and locking devices make all settings hand operated. ■ For full information on how the new Westinghouse PR recloser, with the industry's most advanced timing mechanism, can fulfill your system's coordination needs, call your Westinghouse representative, or write Westinghouse Electric Corporation, P.O. Box 868, Pittsburgh 30, Pennsylvania. You can be sure . . . if it's Westinghouse.

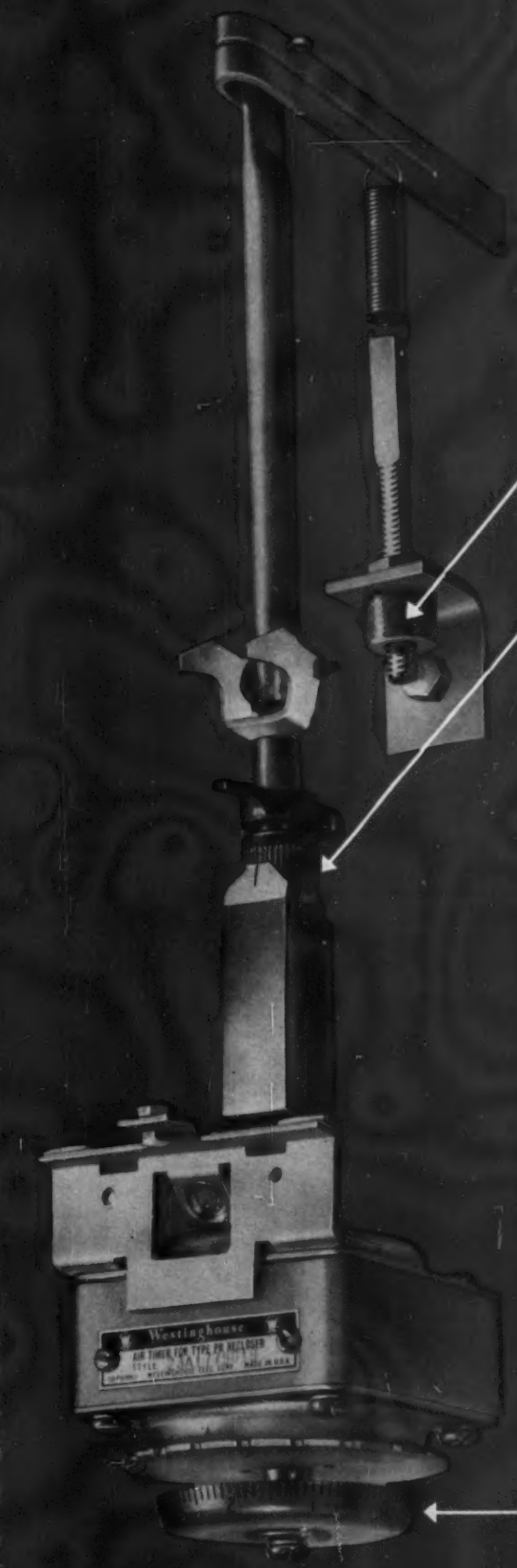
J-60996

PR recloser—frame of pole mounting

	4.8 kv	15 kv
400 amps	6000 amps I.C.	4000 amps I.C.
560 amps	12,000 amps I.C.	8000 amps I.C.

Westinghouse

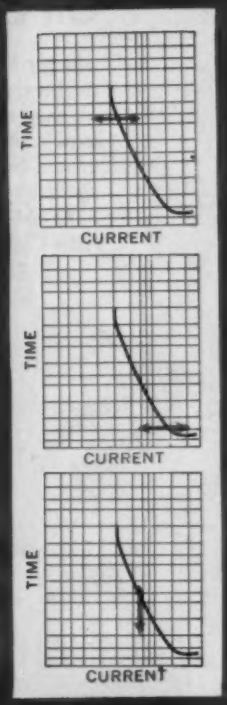




X—Minimum trip current adjustment, knurled nut provides finger-tip accuracy.

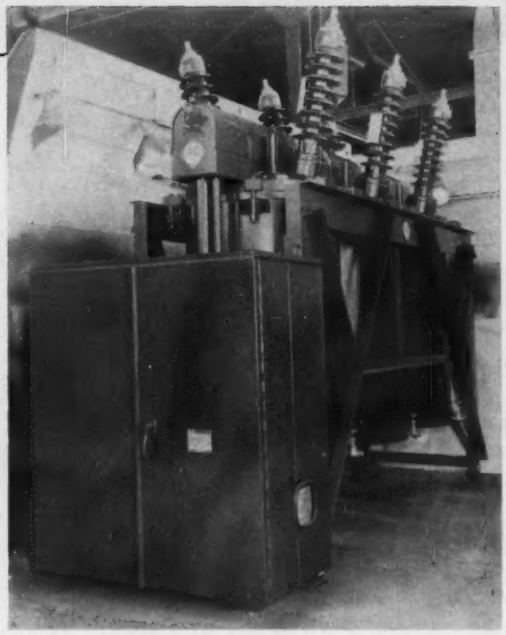
Z—Slope of curve adjustable over wide range.

Y—Shape of curve adjustment with sealed pneumatic timer vernier and locking wheel.



With X–Y–Z adjustments, a composite curve can be produced to coordinate with fuses, reclosers or relays.

Oil Circuit Breaker . . .



. . . for 69 kv is frame-mounted. The unit, an addition to the type FZO line, requires one-third less insulating oil than the base-mounted breaker. Access for maintenance of interrupting devices is quickly and easily gained by lowering the oil-filled tanks. They are raised again by an hydraulic lifter. The interrupting rating is 5,000 Mva.
Allis-Chalmers Mfg Co, Milwaukee 1, Wis.

Control Center . . .

. . . for multiple-motor installations can also incorporate feeder breakers, lighting panels and other distribution devices within its modular compartments. The number of standard enclosures called for can be joined as building blocks to serve low-voltage systems in plants and commercial buildings Each enclosure has a separate front access to the entire vertical wiring trough. Motor starter units have drawout connections for both power and control.
General Electric Co, Schenectady 5, N. Y.

Silicon Rectifier . . .

. . . for electronic precipitators is designed to replace mechanical rectifiers. It calls for low maintenance and few spare parts. It ties in with existing ac connections and dc switchgear. The equipment comprises four independent rectifier units and has a choke in the output line to protect it from high-voltage feedback.
Buell Engineering Co, Inc, 123 William St, New York, N. Y.

(More New Equipment on page 67)

Blackburn Laboratories Develop

New, Improved contax

(Oxide-inhibiting compound)

HARMLESS TO LINEMEN'S GLOVES AND IMPROVES CONNECTION PERFORMANCE

Extensive laboratory tests by Blackburn, confirmed by an independent manufacturer of rubber goods, prove conclusively that BLACKBURN'S Contax has no adverse effect on linemen's rubber gloves and blankets.

In addition, Contax gives improved connection performance. It penetrates the oxides on conductors to reduce connection resistance. It inhibits oxidation and galvanic corrosion by sealing out moisture and air from the connection surfaces.

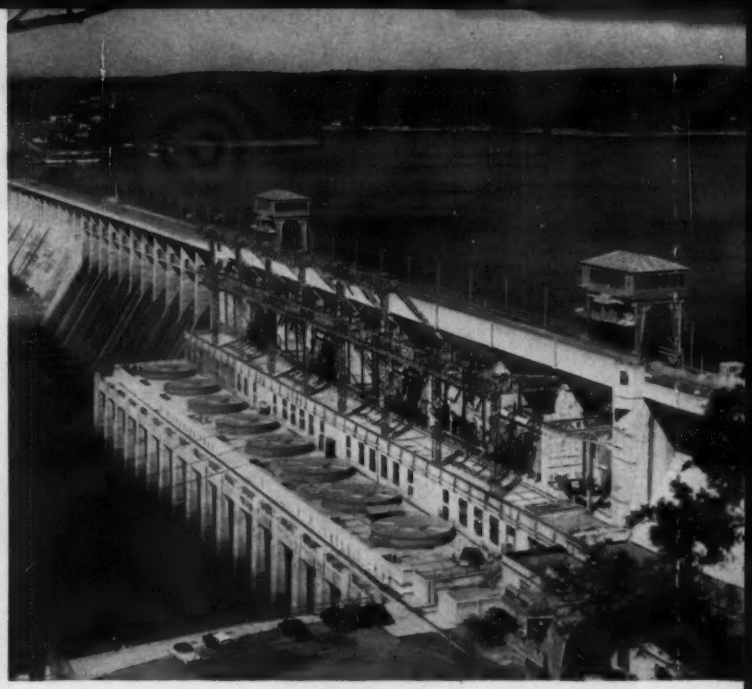
Contax comes in crack-proof, see-through, plastic squeeze bottles. It's a non-petroleum, synthetic polymer grease with suspended zinc particles . . . has an extremely low moisture absorption rate, and is usable over a wide temperature range. Contax is non-toxic and flame resistant . . . will not harm the skin.

For detailed test data, send for Data Folder #6009.

Jasper BLACKBURN Corporation

1525 Woodson Road **St. Louis 14, Missouri**

PROMOTIONAL DISPLAY of dusk-to-dawn lighting is demonstrated by District Manager T. C. Brickey at his office, where customers can operate the lamp by covering the Fisher-Pierce control. "Customer" is E. J. Gildehaus of Union Electric Sales Development and Training Division, which provides displays and other promotional material to regional offices.



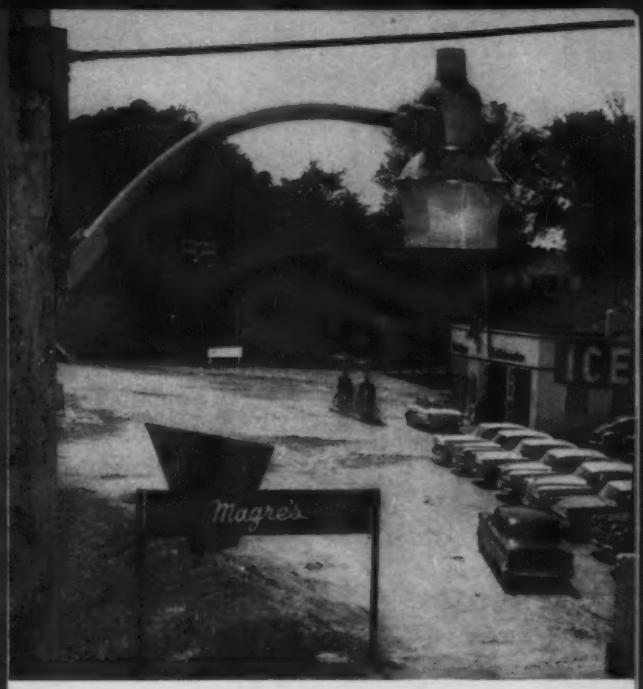
PHOTOELECTRICALLY CONTROLLED lighting service has proved to be a good off-peak load builder for the system's nearly two-million-kilowatt capacity. Average yearly output of Bagnell Dam, shown here, is 440 million kilowatt-hours. (Photo courtesy Union Electric Co.)

In the St. Louis Area . . .

"Dusk-to-Dawn" Lighting Using Fisher-Pierce Controls Provides Cardinal Improvement In Outdoor Lighting

Homes and businesses throughout the Union Electric Company service area can now have all the advantages of adequate outdoor lighting, automatically controlled by F-P Series 6600A photoelectric controls. Vigorously promoted by Union Electric over the past two years, automatic outdoor lighting has steadily grown in popularity. Several thousand F-P controlled installations are already in use, lighting residential yards and driveways, barnyards, advertising signs, lumber yards and other storage and work areas, gas stations, motels, trailer camps, fruit stands and other roadside businesses.

For the utility, photoelectrically controlled lighting is an excellent off-peak load builder, while the use of reliable controls assures lowest maintenance cost. Utility customers appreciate the convenience of *truly* automatic lighting and the protection it offers — protection from vandalism, burglary and accidents. All indications are that automatically controlled lighting will continue to grow in popularity, for the benefit of all concerned.



For complete design information and specifications on Series 6600A controls, write The Fisher-Pierce Co., 82 Pearl Street, So. Braintree 85, Massachusetts.

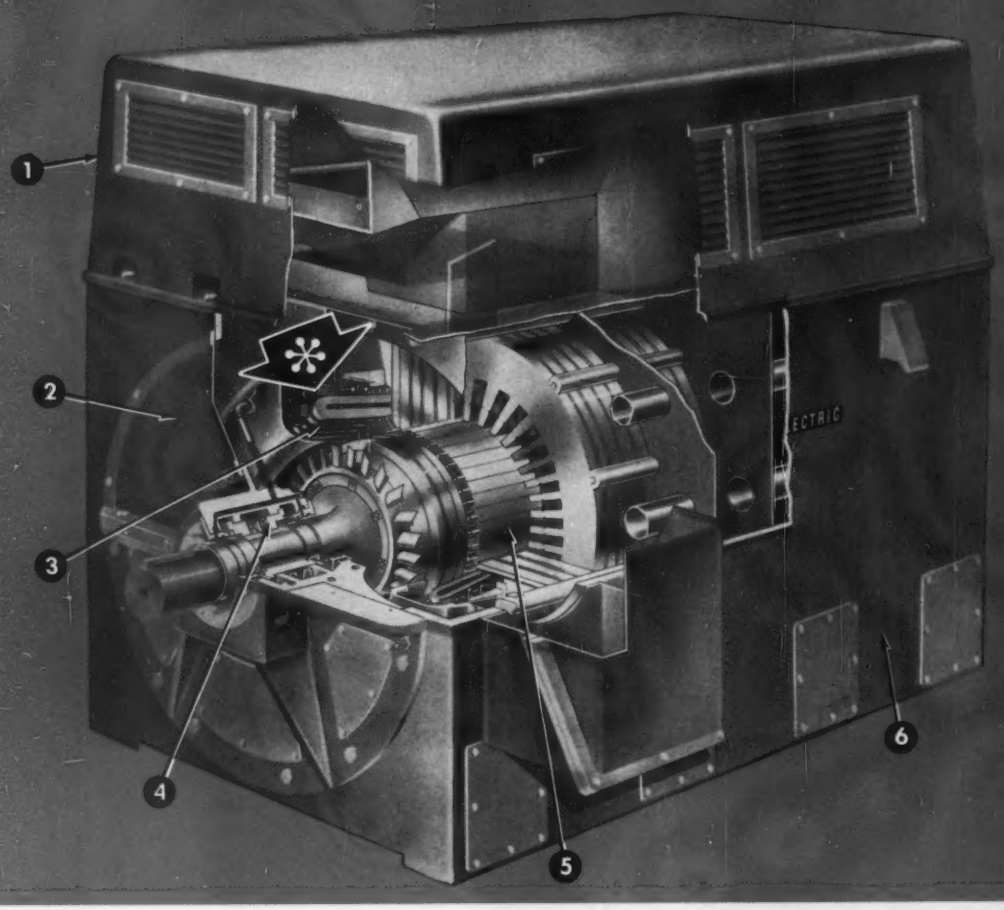
FISHER PIERCE

Manufacturers of Electrical and Electronic Equipment for Industry, Utilities and the Home

AN AFFILIATE OF SIGMA INSTRUMENTS, INC.

NEW General Electric CUSTOM '8000' Boiler Feed Pump Motors . . .

CUSTOM DESIGNED FOR POWER STATION APPLICATIONS



1 **REMOVABLE "TOP-HAT"** provides easy access to motor interior. Top-hat is baffled and lined with sound absorbing materials to attenuate motor operating noise. Rotor and stator are constructed to reduce noise and direct sound waves into the acoustically treated top hat.

2 **NEW END SHIELD DESIGN** reduces time required for inspection and maintenance. One man can quickly unbolt and lift off the upper end shield half and remove the split air deflector. Bearing support is integrally cast with the lower end shield. Lower half of bearing can be "rolled out" for inspection without removing end shield.

3 **EXCLUSIVE POLYSEAL* SUPPORTED SILICONE RUBBER INSULATION SYSTEM** provides superior mechanical, thermal, voltage and environmental endurance—affords top reliability in critical Electric Utility applications.

4 **TRIPLE PROTECTED BEARING SYSTEM** lengthens boiler feed pump motor life. A primary seal is formed by the ring mounted on each end of the bearing shell and adjacent oil slinger machined in the shaft. A multiple groove seal at each end of bearing housing acts as a second line of defense against dirt entrance and oil leakage. In addition to the slingers and close running labyrinth seals, G.E.'s new bearing system utilizes an *Air-Lock* seal in each bearing housing. Air at slightly higher than atmospheric pressure is piped to annular grooves at each end of the bearing. This air pressure acts as a third seal to keep oil locked in the bearing housing.

5 **ROTOR PARTS ARE MACHINED TO PRECISION TOLERANCES** and assembled using especially developed techniques to assure high-speed operational stability.

6 **RUGGED FRAME ASSURES SOLID STRUCTURAL SUPPORT** for stator, end shields, rotor and top-hat. Frame is precision machined to positively align motor parts.

GENERAL ELECTRIC'S "CUSTOMIZED" MOTOR manufacturing philosophy permits the design flexibility, and the adherence to quality control production standards, which assure Electric Utilities of optimum motor performance, reduced operating costs and lower first cost. In keeping with requirements of Electric Utilities, Custom '8000' boiler feed pump motors are available now in ratings to 10,000-hp. 883-01

* Trade-mark of General Electric Co.

Progress Is Our Most Important Product

GENERAL ELECTRIC

NEW

encapsulated connection harness increases mechanical strength, assures maximum motor reliability

General Electric's new encapsulated connection harness consists of two rings of insulated conductors encapsulated in epoxy resins. The larger ring contains motor leads and phase connections, while the smaller ring contains equalizer connections.

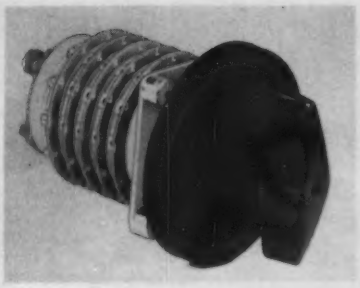
This new system provides greater strength and rigidity at the end turns and assures uniform coil connections. Rigid encapsulation prevents contact between conductors—eliminates insulation abrasion. The epoxy compound provides additional insulation for leads and connections.

NEW ENCAPSULATED CONNECTION HARNESS for General Electric boiler feed pump motors provides an immobilized connection bundle . . . eliminates loose ties and abraided insulation.

YOUR GENERAL ELECTRIC APPARATUS SALES REPRESENTATIVE has full details on new G-E boiler feed pump motors. Call him today. Medium AC Motor & Generator Department, Schenectady 5, N.Y.

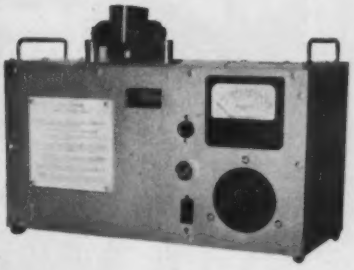
Progress Is Our Most Important Product

GENERAL ELECTRIC



Rotary Switch . . .

. . . with 1 to 25 sections per switch is for control of complex circuits, tap, transfer and selector service. Detents insure positive positioning of the silver contacts. Each insulated element of the ESCO type JM rotary multipole switch is self-contained and is rated at 125 v ac, 5 amp.
Electro Switch Corp, King Ave, Weymouth 88, Mass.



Oil Tester . . .

. . . is portable. The model K35-2-OC is for dielectric testing of transformer oil, askarel and other insulating liquids. Output is continuously variable from 0 to 35 kv at 2 kva capacity. Input is 110 v ac. The oil cup has 1-in. dia flat electrodes spaced 1/10 in. apart and conforms to ASTM standards.
Peschel Electronics, Inc, Patterson, N. Y.

Connectors . . .

. . . for compression tool installation are furnished in sixteen sizes, all with the same outside diameter. The HDC service entrance sleeve is color coded to indicate the proper connector application and it is

(*Continued on page* 70)

Crapo

GALVANIZED STEEL STRAND HAS ALL 5

1. *Strength*
2. *Workability*
3. *Ruggedness*
4. *Long Life*
5. *Economy*

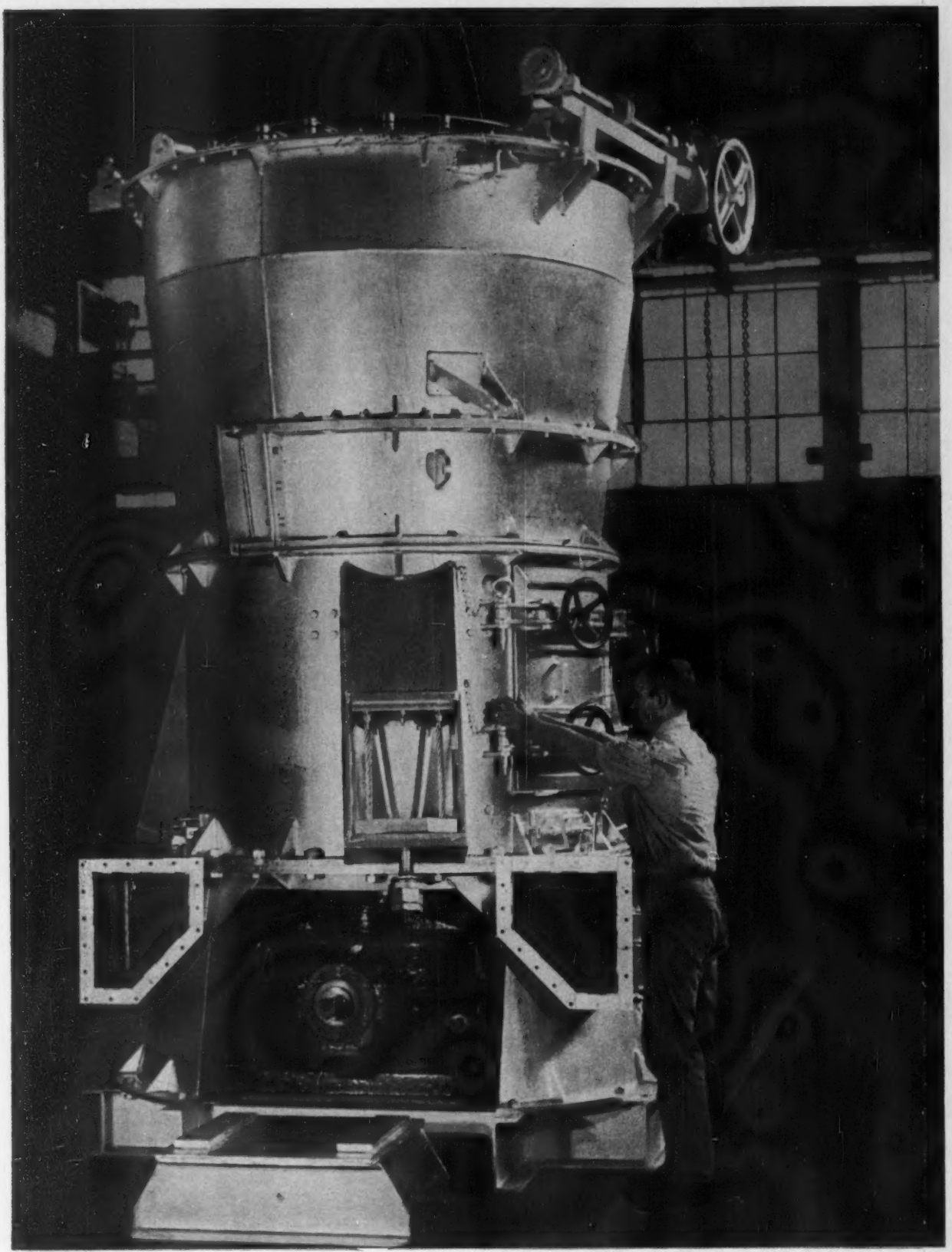
When you select a size and grade of strand for a specific job you want to know that it meets every requirement of that job. You want ample strength to sustain the ultimate load—plus an adequate safety factor. You want pliability for ease of working in the field. You want ruggedness to withstand the abuse which may be encountered during and after installation. You want long, dependable life. And, you want reasonably low first cost and low maintenance costs.

For more than 50 years *Crapo* Galvanized Steel Strand has consistently demonstrated its ability to more than meet all of these requirements. Proof of its reliable performance is to be found in the case histories of overhead power and communication lines throughout the country.

Crapo Galvanized Steel Strand is fully protected against corrosion by heavy, uniform, dense coatings of commercially pure zinc tightly bonded to the individual wires. All grades and sizes are available in A, B and C weights of coating.

For details, ask our distributor or write direct!

INDIANA STEEL & WIRE COMPANY, INC.
Muncie, Indiana



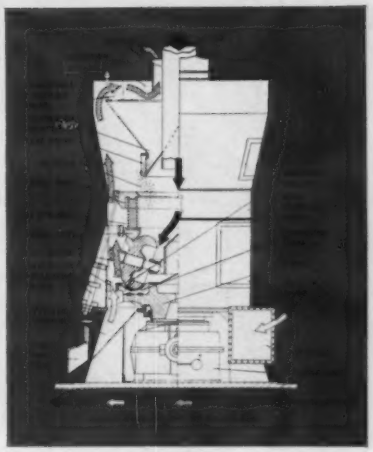
Foster Wheeler MB planetary roll and table pulverizer. Available with capacities from 2 ton/hr to 55 ton/hr.

Foster Wheeler MB Pulverizer, SIMPLE...VERSATILE...RELIABLE

The best combination of advantages for a wide range of fuel requirements

COMPARISON: Foster Wheeler MB pulverizer compared with two other leading pulverizers (A & B) available in U.S.

Power consumption	equal to A & B
Availability	better than A, equal to B
Accessibility	better than A & B
Floor Space	equal to A & B
Flexibility for suction or pressure operation	equal to A, better than B



European power companies have used the MB pulverizer for over 10 years. Low power consumption, low maintenance and the extremely high availability of the design are thoroughly proven.

Now further refined by FW engineers, and tested for two years in the U.S., the MB pulverizer deserves careful consideration in planning any fuel system which may require mill capacities from 2 to 55 tons of pulverized fuel per hour.

The MB design is extremely simple, providing reliability and ease of maintenance. The only moving parts inside the grinding area are three spheroidal rollers, a roller guide, and the powered horizontal grinding table. All adjustments can be made with the mill in operation.

The planetary motion of the rollers maintains uniform product fineness. Wear of grinding surfaces is extremely slow. The rollers and carrier need no lubrication. Noise and vibration levels are very low.

Provision is made for either pressurized or suction operation. In addition to coal pulverizing, the MB mill is also available for grinding gypsum, cement, solid chemicals, pigments, food products and other commercial materials.

Write for Bulletin MB-58-1, giving more detailed specifications for the MB mill. Foster Wheeler Corporation, 666 Fifth Avenue, New York 19, N. Y.

FOSTER WHEELER

NEW YORK LONDON PARIS ST. CATHARINES, ONT.

SAFETY by-the-MILE

with CF&I Galvanized Steel Strand

CF&I Galvanized Steel Strand used as overhead ground wire safeguards your power cables all along the line. It takes the punishment from lightning and shunts it harmlessly aside.

This kind of safety is inherent in every foot of CF&I Galvanized Steel Strand. The wire is expertly drawn from selected steels. After the wire is hot-dipped in zinc for extra weather resistance, it is stranded. The quality controls used in each manufacturing operation assure a strong, safe, dependable grounding wire.

For standard applications, CF&I Galvanized Steel Strand is made to ASTM specification A-363 in seven- and three-wire constructions. For special applications CF&I is equipped to manufacture strand to your own specifications.

For complete details and delivery schedules, contact your local electrical distributor.

CF&I STEEL

GALVANIZED STEEL STRAND
THE COLORADO FUEL AND IRON CORPORATION

In the West: **THE COLORADO FUEL AND IRON CORPORATION** — Albuquerque • Amarillo • Billings • Boise Butte • Denver • El Paso • Farmington (N. M.) • Ft. Worth • Houston • Kansas City • Lincoln • Los Angeles Oakland • Oklahoma City • Phoenix • Portland • Pueblo • Salt Lake City • San Francisco • San Leandro Seattle • Spokane • Wichita

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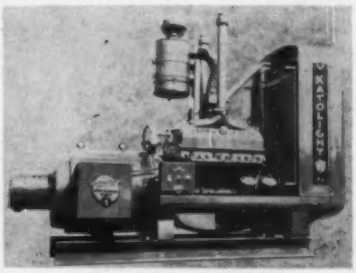
CF&I OFFICE IN CANADA: Montreal

CANADIAN REPRESENTATIVES AT: Calgary • Edmonton • Vancouver • Winnipeg

Connectors . . .

(*Continued from page* 67)

easily taped. Ranges are No. 1/0 AWG to No. 4/0 ACSR main, No. 4 AWG to No. 4/0 ACSR tap.
Anderson Electric Corp, Drawer 2151, Birmingham 1, Ala.



Generator . . .

. . . rated at 125 kw in standard voltages comes equipped with voltage regulators and either static or rotating exciters. The V8 engine can be furnished for propane, gasoline or natural gas. A variety of controls and signal devices is also available.
Katolight Corp, Mankato, Minn.

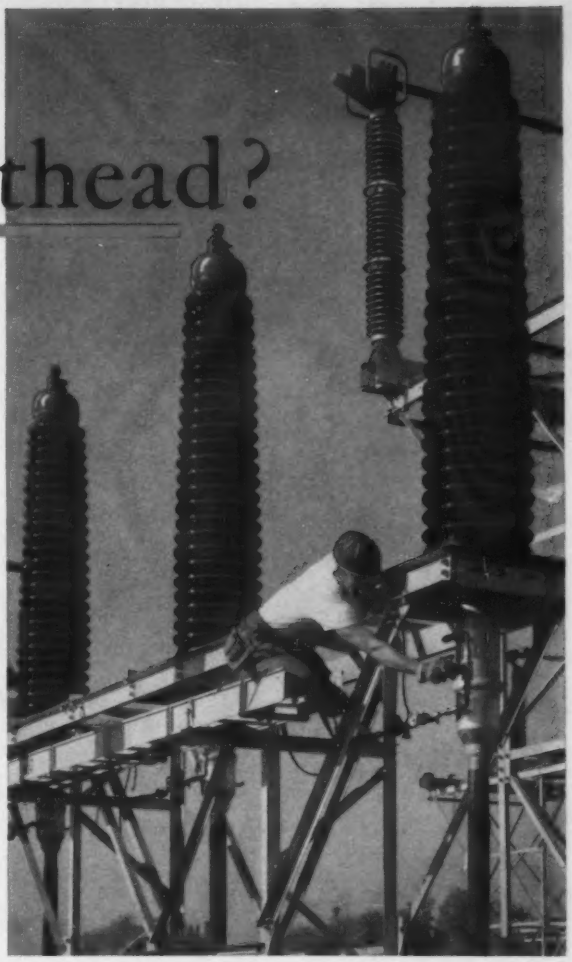
Dc Motors . . .

. . . and generators offer high-temperature silicone insulation and controlled high-capacity ventilation. The Life-Line H machines are totally enclosed.
Westinghouse Electric Corp, Box 2099, Pittsburgh 30, Pa.

Correction

The G&W Specialty Company's type FC72 oil-fuse cutout described in *Electrical World,* Aug. 29, p 88, has an interrupting rating of 100,000 kva symmetrical 3-phase instead of 100,000 amp as printed.

What Is A Pothead?



Terminating a metallic sheathed or shielded cable creates an abrupt discontinuity in electrical characteristics of the cable. Electrostatic stresses that have been resolved by optimum balance of dielectric components within run of the cable itself are disturbed at a cable end when sheath and/or shielding are stripped away from the conductor insulation.

Rubber and plastic insulations exposed to the elements are subject to deterioration caused by sun, rain, industrial fumes, salt spray, and the like. Oil-impregnated paper insulation absorbs moisture readily, and if exposed to the atmosphere would soon cease to be an insulator. Creepage distance along the surface of insulation from bare conductor to ground becomes significant and can result in tracking and eventual flashover.

All these conditions are overcome by a pothead to the degree required by system design and BIL level desired. A pothead provides:

1. An hermetic seal of the cable end to prevent contamination of cable insulation by moisture or liquid dielectrics used in equipment to which the cables are connected.

2. An impervious porcelain insulator to protect cable insulation against weather and adverse contaminating atmospheric conditions.

3. Physical protection and mechanical support of the cable conductors, insulation sheath, armor, and so forth.

4. Means for making external electric connections with the cable conductors within the pothead housing.

5. A compact, economical housing providing adequate dielectric strength (including that of the cable end) considerably greater than can be accomplished by any other means within the same space.

Unlike a bushing, where characteristics are controlled by complete factory assembly and test of the whole device, the pothead manufacturer can provide in finished form only a portion of the whole termination. With a pothead termination, the cable, stress-relief cone, and dielectric compound must be assembled with the basic pothead in the field at time of installation. Successful operation of the termination requires proper combination of all these components.

Years of development work and of operating experience have resulted in a thorough understanding by G&W engineers of electrical and mechanical requirements for pothead terminations. From this has evolved the most complete line of pre-engineered standard potheads with improved gasket materials, superior porcelain designs, hermetically-tight metal-to-porcelain bonds, and an array of interchangeable pothead entrance fittings.

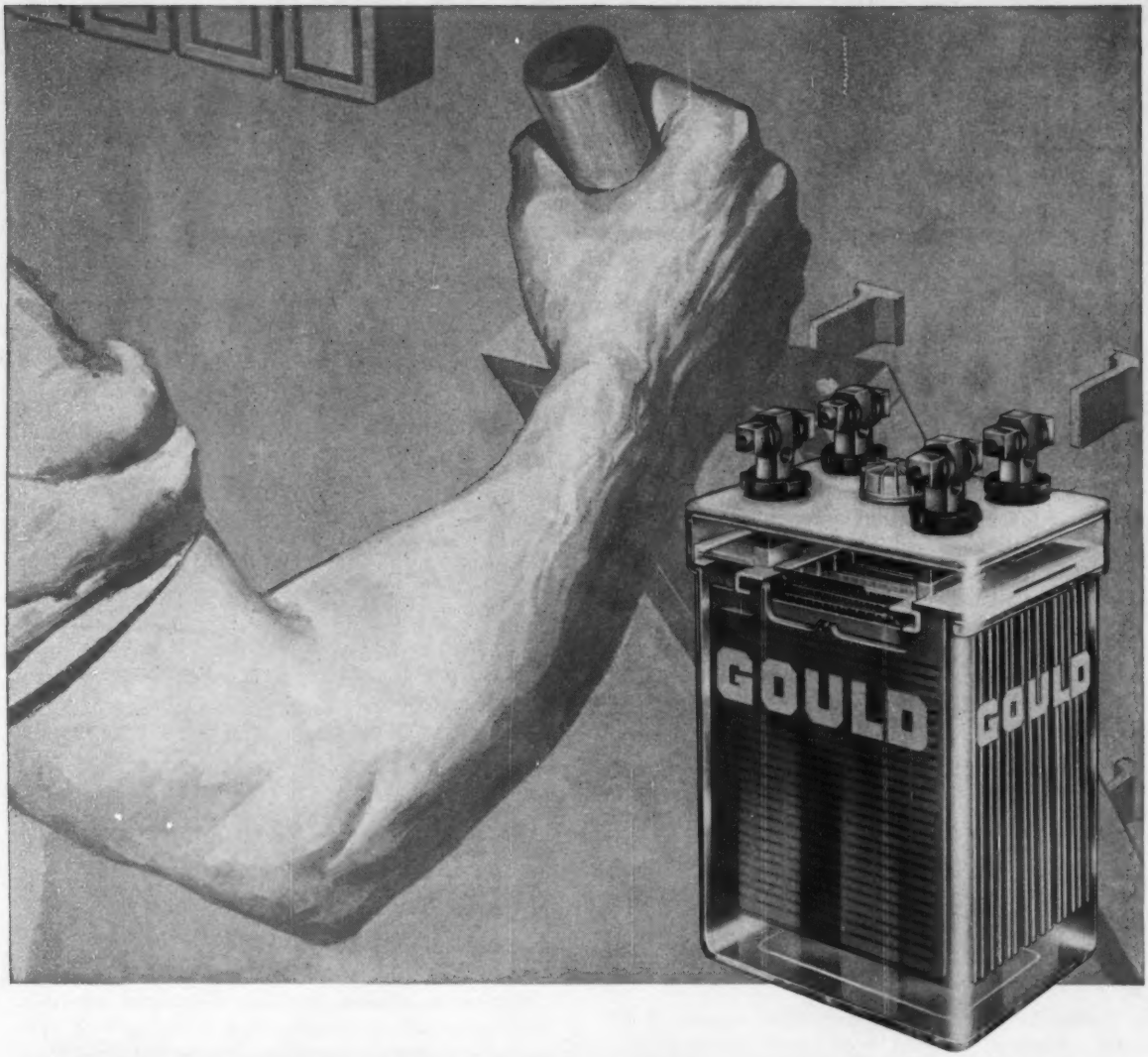
G&W knowledge of pothead-design fundamentals, use of materials of the highest grade, flexibility of component parts, and good installation techniques will help you make better cable terminations for more reliable transmission of electric power with underground cables.

G&W representatives welcome the opportunity to consult with you on your present and future cable-termination requirements. G&W's unique engineering service is available without obligation.

G&W ELECTRIC SPECIALTY COMPANY
3500 WEST 127TH STREET • BLUE ISLAND, ILLINOIS
CANADIAN MFG. • POWERLITE DEVICES LTD. • TORONTO, MONTREAL & VANCOUVER

superior quality standards — inspired specialized design

A 60-1



Big power when you need it...

GOULD Stationary Batteries

In emergencies—when quick, reliable current is needed for longer than a moment—new Gould Stationary Batteries in Plastrite Jars offer long, trouble-free service either full float or cycle operation.

Dependable power through proper design. New Silicone O-Ring post seal expands under compression, prevents escape of electrolyte. New stronger posts assure full current-carrying capacity with maximum voltage. Improved element suspension eliminates cover breakage due to weight of battery element.

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Electrical World

OCTOBER 3, 1960

Management Newsletter

These Price Earnings Ratios More Than Doubled in Decade

COMPANY	PRICE EARNINGS RATIO 2/18/60	3/10/50	10-YEAR INCREASE	REVENUES (millions)	REGIONAL LOCATION
Florida Power & Light	27.7	9.9	180%	$155	South
South Carolina E&G	21.2	7.7	176	55	South
Citizens Utilities	18.4	7.0	163	9	Various
Tampa Electric	30.0	11.4	163	36	South
Arizona Public Service	20.1	8.0	145	61	Southwest
Central Louisiana Electric	19.5	8.2	138	20	South
Texas Utilities (holding company)	24.5	11.1	121	183	Southwest
Tucson Gas, Electric & Power	21.5	9.8	120	20	Southwest
Colorado Central Power	20.7	9.8	111	7	West
El Paso Electric	22.2	10.7	108	17	Southwest
Florida Power	26.3	12.7	107	62	South
Central & Southwest (holding company)	24.3	12.0	102	156	Southwest

How Utility Commons Fared in the Fifties—I

Electric utility investors made spectacular gains in the stock market during the 1950's. Prices of most utility commons more than doubled. But other investors did well too; in fact, even better. While the Dow Jones utility average climbed 113% during the decade ending December 31, 1959, the Dow Jones rails zigzagged past them for a gain of 192%. And the Dow Jones industrials, during the same 10 years, galloped off in a breathtaking burst that carried prices up 240%.

What caused this remarkable gain in the market? This week, the Management Newsletter sights back on the Fifties to find out; to sort out the pressures that eventually caused utility stocks to more than double in price. Two basic forces were at work in the market: **(1)** Investors were willing to buy at higher price earnings ratios (PER), and **(2)** Most companies were turning in higher earnings per share. These two influences determine market price. But how, and why, did each actually affect price? This week, we concentrate on the first of these influences, price earnings ratio, to see. The second part of this series will deal with improved earnings, and the final part will deal with overall effect on market price. Part II will be published next week.

The price earnings ratio (the number of dollars an investor will pay for $1-per-year of company earnings) results from a host of factors. These may include the company's dividend and financial policies, its territory, its rate climate, its capital structure and growth possibilities, to name a few.

Not one or two of these factors, but the entire mix, determines price earnings ratio for a given company. Price earnings ratio is, essentially, a company's "investment personality," as seen by the share buyers and security analysts. But, like personality, a price earnings ratio is partly endowed, partly created.

It is *endowed* by its surroundings. Some utilities, as those in Texas, operate under a more favorable rate climate than many others, thus they can expect a higher price earnings ratio. And some utilities are fortunate to do business in a growth area, such as Florida. But no amount of management effort can make Vermont, for example, into another Florida.

On the other hand, management's efforts can *create* a healthy price earnings ratio too, by adopting safe (but aggressive) capital structures, wise dividend policies, prudent cost controls, and dynamic public relations. Nourished in this fashion, how did utility PERs actually perform in the Fifties?

Which Price Earnings Ratios climbed most rapidly? Industry-wide price earnings ratios gained 31% over the decade. This is based on the fact that electric utility common stocks were selling at 12.5-times earnings back in March, 1950, according to statistical data prepared by C. A. Turner of Chicago. By March, 1960, that figure had reached 16.4-times earnings.

The March, 1960, figure is based on 115 electric operating utilities, plus 10 holding companies. As of March, the operating companies were posting price earnings ratios of 16.3, while the holding companies, faring a little better, were averaging 18.3-times earnings. Looking back, it is not possible to compare this current data precisely with that of 10 years ago. While 115 operating companies appear in both 1950 and 1960 Turner listings, the companies vary in about a dozen cases. This reflects shifts in company names and amalgamations that occurred during the decade. Likewise, while only 10 holding companies appear in the 1960 list, the 1950 list contained 12.

While the average utility price earnings ratio rose about 31% during the decade, a few raced ahead three or four times faster. Which issues were the standouts? The Turner list shows at least 12 companies *more than doubled* their price earnings ratios during the decade (see chart on first page; in most cases PERs are based on 1949 and 1959 earnings, respectively).

Clearly, companies in the South and Southwest shared top honors. Five of the 12 companies listed in the first table are situated in the South, with the leader (Florida Power & Light Co) as well as three of the top four, serving Florida. Five more companies in the list are in the Southwest, principally in Texas and Arizona. One of the two remaining companies serves Colorado, while the other, Citizens Utilities Co, operates a number of systems throughout the nation.

What Caused This Dramatic Climb in PER?

Good fortune placed the 12 companies in great growth areas. But this was not the sole reason for their doubled-or-better PERs. Most of the 12 companies had a "head start" factor. Stocks in most of them appear to have been *underpriced* back in 1950, which gave them a lower base on which to build their startling percentage climb. Seven of the companies, with an average price earnings ratio of 9.2 in 1950, fell into a size group which had a higher average PER—10.8. Furthermore, all but one of these seven fell below the 10.8 group average.

Three more companies, with average 1950 price earnings ratios of 10.1, fell into a second size group whose overall average was 12.15 (only one of these three companies scored higher than this 12.15 average).

The last two companies, both holding companies, had 1959 average price earnings

These Price Earnings Ratios Increased More Than 2/3

COMPANY	PRICE EARNINGS RATIO 2/18/60	3/10/50	10-YEAR INCREASE	REVENUES (millions)	REGIONAL LOCATION
Southern Co (holding company).....	21.2	10.8	98%	$297	South
Public Service of Colorado.....	20.8	10.7	94	104	West
California Pacific Utilities.....	15.2	8.4	93	10	West
Missouri Utilities	16.6	8.7	91	8	Midwest
West Penn Electric (holding company).	14.9	7.8	91	151	East
Southwestern Electric Service.....	17.4	9.2	89	4	Southwest
Columbus & Southern Ohio Electric...	17.3	9.3	86	52	Midwest
Public Service of New Mexico.....	22.3	12.0	86	17	Southwest
Southern Colorado Power.....	16.3	8.8	85	8	West
Montana Power	16.5	9.0	83	28	West
Virginia Electric & Power.....	21.8	12.0	82	151	South
Houston Lighting & Power.....	21.8	12.1	80	106	Southwest
Middle South Utilities (holding company)	18.7	10.4	80	199	South
Missouri Public Service.....	16.5	9.2	79	17	Midwest
Duke Power	20.3	11.4	78	153	South
General Public Utilities (holding company)	15.0	8.6	74	231	East
Iowa Southern Utilities.....	13.7	7.9	73	17	Midwest
Interstate Power	15.9	9.2	73	54	Midwest
Delaware Power & Light.....	21.2	12.3	72	53	East
Utah Power & Light.....	19.1	11.1	72	50	West
Carolina Power & Light.....	16.9	9.9	71	77	South
American Electric Power (holding company)	20.9	12.4	69	324	East
Northern Indiana Public Service.....	16.1	9.5	69	104	Midwest
San Diego Gas & Electric.....	15.2	10.0	69	71	West
Kansas Gas & Electric.....	18.3	10.9	68	36	Midwest
Atlantic City Electric.....	21.6	12.9	67	38	East

ratios of 9.93, compared with a 1950 average for holding companies listed of 11.3 (one of them was above this 11.3 average, the other below).

Thus, nine of the top 12 companies had price earnings ratios that were below average for other utilities of the same size. Clearly, then, a large part of the sensational 10-year gain in price earnings ratios may be laid to *formerly depressed* prices. These companies were able to start from scratch, and found it easier to rise when the entire industry upgraded during the 1950's. This, of course, doesn't detract from their remarkable record in more than doubling price earnings ratio.

Other Utilities Did Well Too

Twenty-six utilities made gains of two-thirds or more in price earnings ratio during the Fifties (chart above). But unlike the first group of companies, which were located primarily in the South and Southwest, the group that did two-thirds or better shows wide geographic scattering. Seven of the 26 are in the Midwest, six are in the West, while five each are in the South and East, and three are in the Southwest.

This regional scattering shows that substantial gains in price earnings ratios for these companies apparently arose from factors affecting the companies themselves, as opposed to regional location.

These 12 Price Earnings Ratios Lead the Pack

COMPANY	PRICE EARNINGS RATIO 2/18/60	REVENUES (millions)	REGIONAL LOCATION
Tampa Electric Company.....	30.0	$ 36	South
Florida Power & Light Company	27.7	155	South
Florida Power Corp.....	26.3	52	South
Central & Southwest Corp (holding company)	24.3	156	Southwest
Texas Utilities Co (holding company)	24.0	183	Southwest
Savannah Electric & Power Company	22.6	12	South
Southwestern Public Service Company	22.5	49	Southwest
Public Service of New Mexico..	22.3	17	Southwest
El Paso Electric Company.....	22.2	17	Southwest
Gulf States Utilities Company..	21.9	98	South
Houston Lighting & Power Company	21.8	106	Southwest
Virginia Electric & Power Company	21.8	151	South

Again, underpricing of these stocks in 1950 was widespread. Of the 26 companies in the table, 16 had 1950 price earnings ratios that were below the average for even the smallest companies in the 1950 tables. And, of the remaining ten companies, seven appear to have had 1950 "size factors" that would have placed them below the average for their particular 1950 size group.

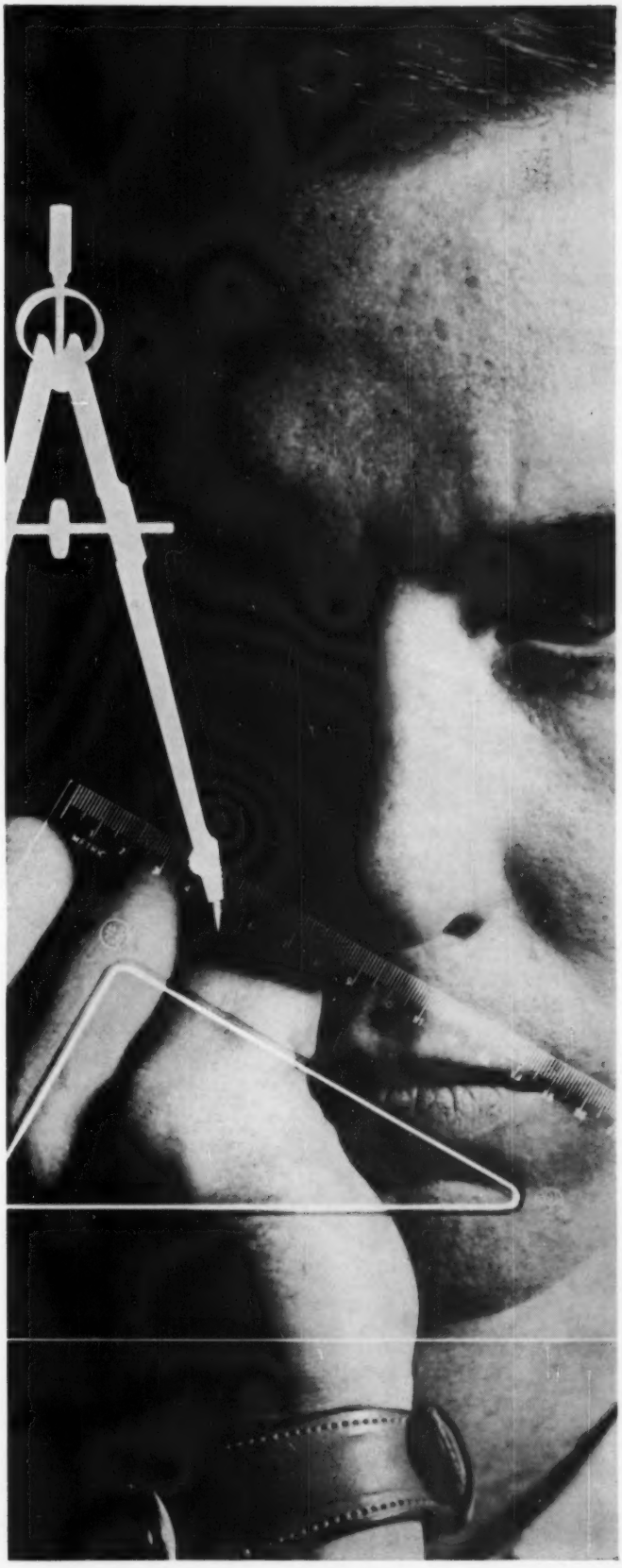
These Twelve Take Top Honors

Spectacular gains in price earnings ratios are one thing. But reaching and maintaining a presently high price earnings ratio is another. A very high price earnings ratio is something a company can regard with considerable pride, reflecting, as it does, a high degree of investor confidence in the company, its management and future prospects.

The table above shows the 12 utilities that have achieved highest price earnings ratios. The figures are based on February 18, 1960, market prices and 1959 earnings so that they will be comparable with the other figures in the study. In almost every case, price earnings ratios for these 12 companies are actually higher today than they were on February 18.

Notice that the size of a company is not of prime importance in achieving a high price earnings ratio. While two of today's top 12 utilities are large holding companies, five of the ten remaining companies are relatively small, with gross annual operating revenues below $50 million.

Location of company, not size, is the chief determinant of an extraordinarily high price earnings ratio. Every one of the 12 top companies operate in the South and Southwest (with six companies in each region). Eastern, Midwestern, and Western companies are completely unrepresented. This doubly underscores the importance investors and analysts place on growth today in fixing price earnings ratios.



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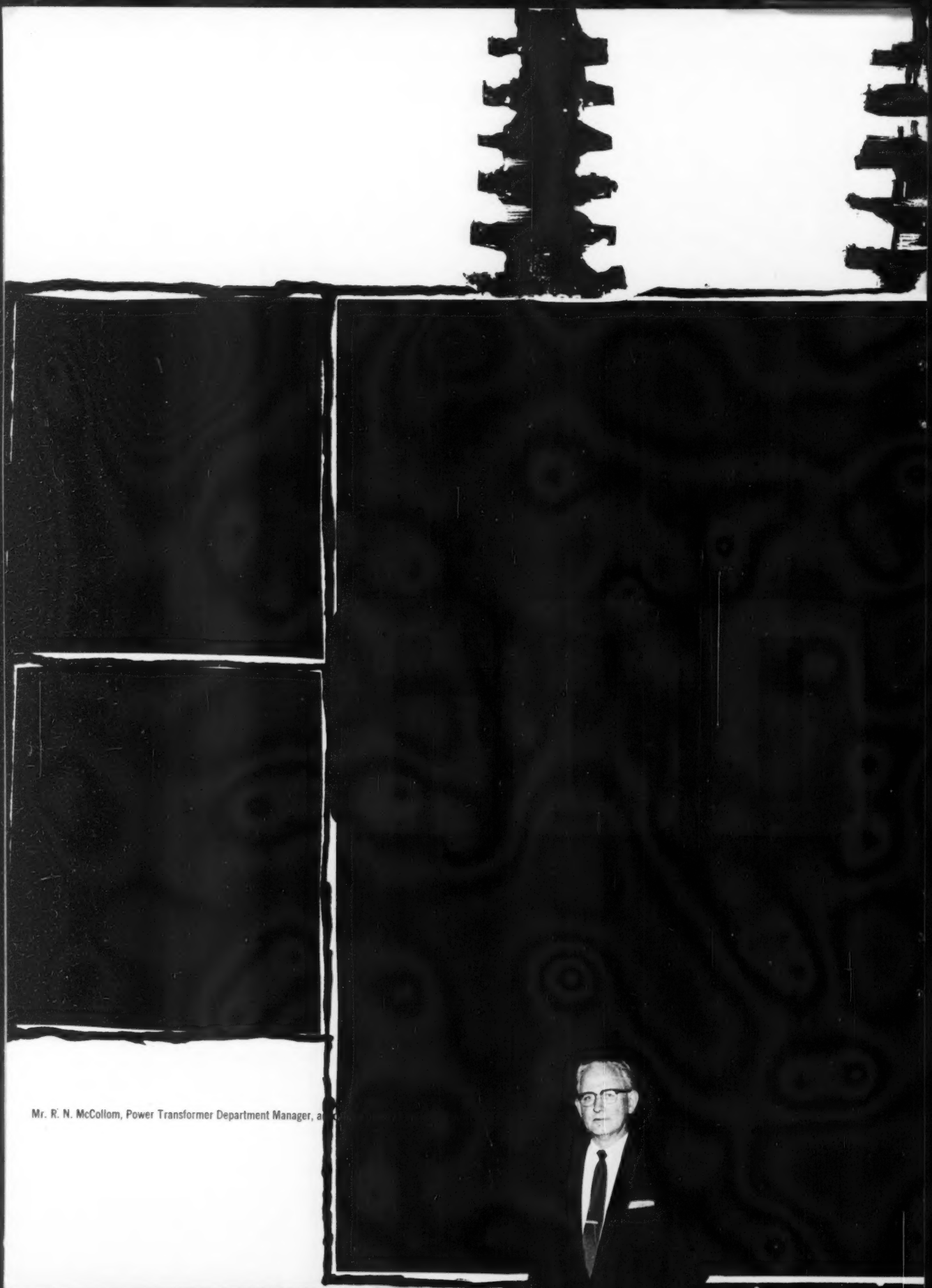

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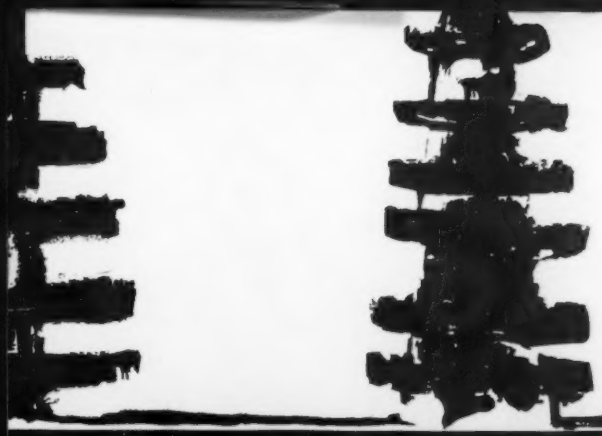

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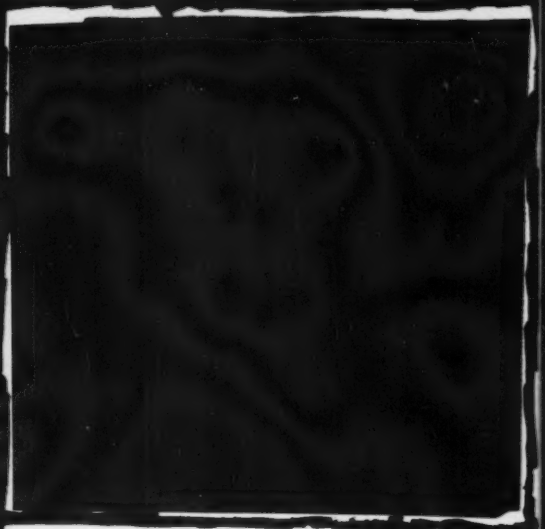

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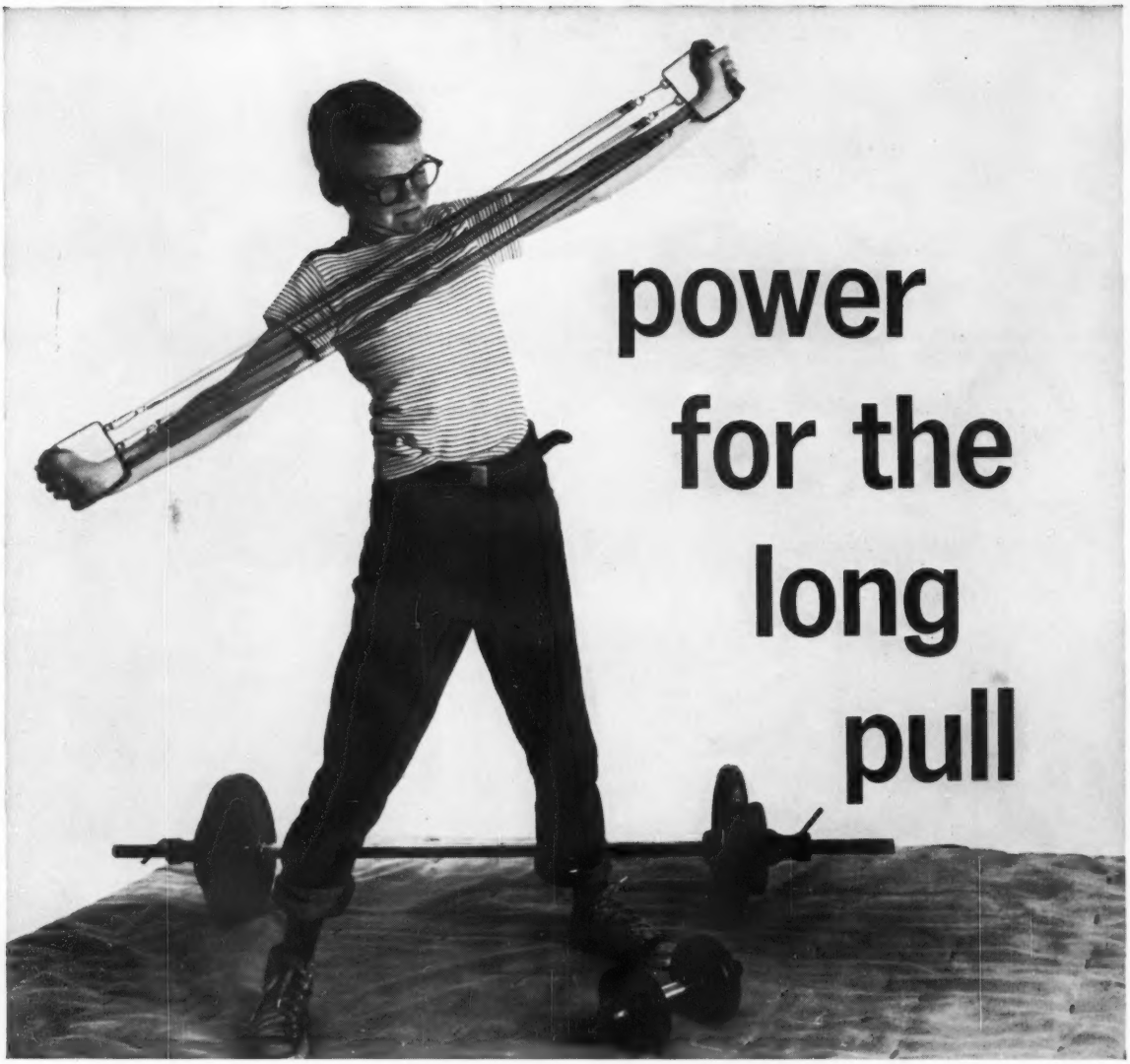

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Crime Flourishes In Darkness . . .

N.Y. Fights Back With $28.8-Million Program

One of crime's worst enemies—modern street lighting—is going to come to the rescue of New York City's harassed and over-worked police force.

Faced with a problem common to cities and towns across the country —rising levels of crime—New York City has embarked on a 6-year lighting program.

To tackle the massive job, New York's Department of Water Supply, Gas and Electricity recently asked for, and got, an appropriation of $8 million from the city's Board of Estimate.

This is a sharp increase over the $2-million budget allocation of previous years, and the $3 million expended in 1958-59.

Before the project is finished, WSG&E Commissioner Armand D'Angelo said New York's 5,800 miles of streets will be bathed in two-and-one-half times the light now provided.

Altogether the Board of Estimate has approved an allocation of $28,-810,000 for the total program which will cover six years. D'Angelo, however, has asked for $73 million to provide 200,000 new lighting units. The over-all plan includes new lighting not only in crime areas, but for public works projects (schools, hospitals, courts, libraries, etc.); housing projects, public and private; community works projects including churches, theaters, community centers; and commercial areas such as shopping, recreation and sports centers.

After three years of pilot studies in crime-ridden precincts, the world's largest city found what other American cities are also discovering —the criminal's most effective ally is darkness.

From such large industrial cities as Cleveland to small midwestern communities like McPherson, Kansas, (EW, Dec. 14, 1959, p 98) forward-looking municipal officials are investing more and more dollars into relighting their communities.

Reduced crime rates show the "profit" in such moves: In one city, burglaries are down 92%; in another, assaults decreased 75%; while another community cut robberies 27% by relighting.

New York's program began three years ago when D'Angelo went to the Police Department and asked officials to select five areas they would like to see relighted to help cut crime (EW, Nov. 2, 1959, p 50-53).

Police pinpointed the five precincts with high crime rates and D'Angelo's department went to work. More than $500,000 was spent equipping the areas with new mercury vapor units.

Meanwhile, police kept tabs on the incidence of various kinds of crime in those areas. Initial results told a dramatic story: All crime

dropped 71%; crimes of personal violence were sliced practically in half.

The Commissioner also checked the economics of the pilot installations. "The $500,000 spent in 1958-59 was of measurable 'profit' to the City of New York," he said. "In addition to the drastic reduction in crime, the number of traffic fatalities decreased in neighborhoods where adequate lighting was installed, proving the economics of such a move beyond further question."

Then city officials swung into action and mapped out a program to relight the entire city. "The Board of Estimate cooperated handsomely," according to D'Angelo. "They approved an expenditure of more than $28 million for the next six years. The initial 1960 budget provides $8.3 million for relighting streets, highways, play areas, shopping centers, housing areas and parks."

D'Angelo pointed to the new appropriation as the only way to achieve a planned orderly relighting program. He labeled previous relighting efforts "patchwork improvements," in which isolated spots were equipped with modern lighting units. Those efforts are no substitute for a planned area-by-area relighting program, he said.

The department's long-range goal is to replace about 200,000 incandescent lighting fixtures with new mercury vapor units capable of shedding two and one-half times the old light. D'Angelo said that the new units will also be cheaper to operate.

"The installation of a 400-w mercury vapor luminaire will give 120% more light than a 585-w incandescent lamp and yet save $7.30 a year in operating cost," he said. And he estimates that the six-year program, if fully implemented, will produce savings of about $466,000 a year traceable to the use of mercury vapor luminaires.

The electrical department's program has spurred other groups to examine their own bailiwicks. The City Housing Authority has begun a $500,000 program to improve outdoor lighting in 80 public housing developments in a move to discourage crime.

Lighting Brackets Raised

The project includes installation of new fixtures and lamps in 5,000 locations. In others, lighting brackets outside buildings will be raised 15 to 20 ft to spread the light across courtyards; and trees, which can block off 30% of the light, will be pruned to provide clear light paths.

Mercury vapor lamps will be installed in areas that suffer most from vandalism, William Reid, chairman of the authority, said.

At the same time, the Triborough Bridge and Tunnel Authority has plans to relight the city's bridges; Manhattan's borough president has authorized funds to provide new tunnel lighting for the east side's Franklin D. Roosevelt Drive, and merchant and civic associations all over the city have come forth to sponsor new lighting programs for their areas.

A parallel program to relight New York playgrounds was begun last fall after two boys were knifed to death in a dark west side playground.

Forty-one playgrounds have already been adequately relighted, but police still classify 392 playgrounds under the Parks Department jurisdiction as after-dark danger areas.

Although the city has a long way to go in this area, tangible results have already been tabulated.

The Parks Department has pointed to a drastic reduction in vandalism in the relighted playgrounds. Vandalism in Staten Island's relighted play areas has been virtually wiped out; in Brooklyn it is down 86%; Manhattan, 81%; and Bronx and Queens play areas both reported 50% decreases in vandalism.

Floodlighting Helps Cut Littering

"Furthermore," added Samuel M. White, the Parks Department's director of maintenance and operations, "such floodlighting has diminished indiscriminate littering of playground areas with broken bottles, beer cans and other materials."

New York's Police Commissioner Stephen P. Kennedy said he is greatly encouraged by the results of the relighting program and hopes it will continue and be expanded.

"Better lighting is a great and effective aid to enforcement," Kennedy declared. "There is no doubt that increased lighting decreases crime."

He pointed out that it is particularly effective in the early hours of the morning when streets are largely deserted and lone policemen are responsible for wide areas.

Refrigerator Replacement Could Add $6 Million

Utilities in the Rocky Mountain area could add $6 million in revenue if they just replaced the older refrigerators in their customers' homes.

Right now nearly one home in three in the Colorado-Wyoming area has a freezer. This compares with one in five for the nation. The actual ownership difference has meant almost $1 million a year in revenue to Rocky Mountain Electric League utilities, J. J. Anderson, marketing manager, Westinghouse Electric Corp's Major Appliance Division, told the group at its recent meeting in Denver, Colo.

Dealer shares in this freezer market have amounted to $13 million. If all the older refrigerators were replaced it would mean $100 million in retail sales.

But, Anderson said, in commenting on 1960 business, one year doesn't make a decade and it is a mathematical certainty that the Sixties will soar. But the appliance industry must fight to get its share of the boom.

The industry's share of the type of dollars the consumer spends on appliances has dropped 14% in five years, and it may drop another 10% in the decade ahead unless the appliance industry moves away from price promotion and sells the excitement, glamour and features of its products.

"A home using less than 4,000 kwhr of electricity annually isn't even in the third grade of convenience and leisure," Anderson told the group.

BENDIX G-20

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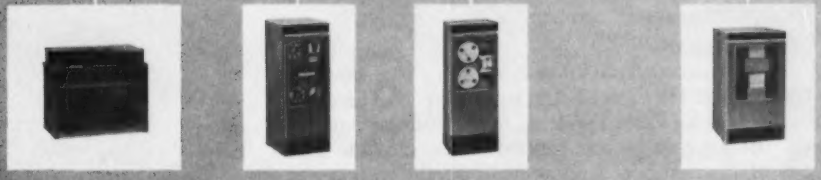

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THE Bendix CORPORATION

Bunnell, Perez Made VPs of Florida Power

BUNNELL

PEREZ

Two new vice presidents have been elected by Florida Power Corp. M. F. Bunnell was named vice president in charge of public relations, and A. P. Perez, vice president of operations.

A 34-year veteran of the utility, Bunnell served as director of personnel for a number of years before being made manager of industrial relations in 1957. He is active on personnel committees of the Edison Electric Institute and the Southeastern Electric Exchange.

Perez had been in charge of the company's electrical design department. A registered professional engineer in Florida and Georgia, he is a member of the Florida Engineering Society and the National Society of Professional Engineers.

Circle Wire & Cable Has New Sales Vice President

Cerro De Pasco Corp has named S. Manuel Pearl sales vice president of its Circle Wire & Cable Corp. He succeeds the late Harry W. Goodman.

Pearl has been associated with Circle Wire & Cable for the past five years as sales manager. Before that he was general manager of the Electrical Products Division of International Rolling Mills Product Co.

He is one of the pioneers in the manufacture of fluorescent lighting equipment and was the former of Work-O-Lite Co, producers of fluorescent equipment.

S. MANUEL PEARL ▶

Barry Named General Sales Manager of Arkansas P&L

A 35-year veteran of Arkansas Power & Light Co, Edward G. Barry, has been named general sales manager.

For the past 10 years Barry has served as commercial sales manager in the company's general office sales and development department.

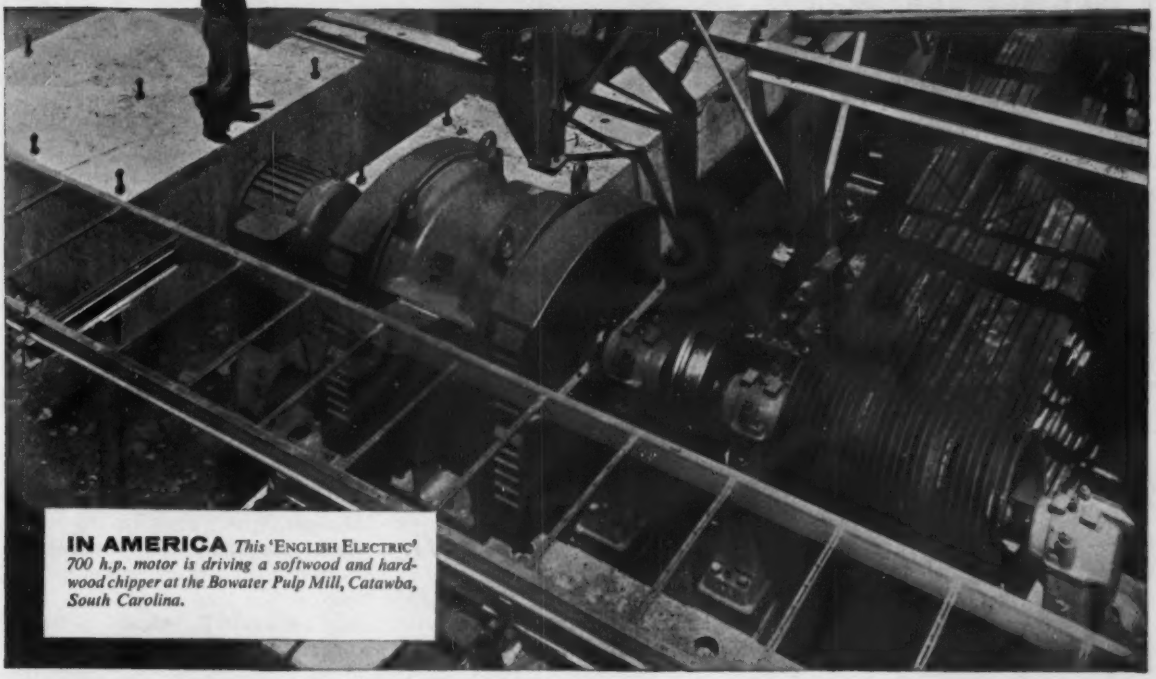
In his new post he will have charge of the power company's sales and promotion activities.

He began his utility career with the utility system serving Hot Springs, Ark., in 1925. When AP&L leased the system in 1943, Barry became a salesman. From there he advanced through the positions of power salesman, division sales manager, and manager of the company's operations at Arkadelphia.

◀ EDWARD G. BARRY

(*More News About People, p* 86)

"Start her rolling!"



IN AMERICA *This* 'ENGLISH ELECTRIC' *700 h.p. motor is driving a softwood and hardwood chipper at the Bowater Pulp Mill, Catawba, South Carolina.*

Throughout the world new 'wheels' of commerce start rolling. At Catawba, near Rock Hill, South Carolina is the latest pulp mill of the Bowater organisation. Here 400 tons of sulphate pulp (the valuable strengthening element in most forms of paper) is produced from each day's consumption of 800 cords of pine.

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IN THE PHILIPPINES

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IN SOUTH AFRICA

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Osgood & Associates, Inc.	988, Spring Street, N.W., P.O. Box 7383, Station C, Atlanta, Georgia, for Georgia, Alabama, Tennessee and South Carolina.
Peabody Brothers.,	2903 St. Louis Street, at Oakland, Dallas 26, Texas. Branch offices in Houston and Tulsa, for Texas, Oklahoma, Arkansas and New Mexico.
Flagg, Brackett & Durgin, Inc.,	183 Essex Street, Boston 11, Massachusetts, for Massachusetts, Rhode Island, Maine, New Hampshire and Vermont.
Charles R. Lee & Associates, Inc.,	3796 West Flagler Street, Miami 44, Florida, for Southern Florida.

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Timmerman Appointed VP At Memco Engineering

Memco Engineering & Manufacturing Co Inc has appointed J. W. Timmerman vice president in charge of engineering and manufacturing.

Timmerman joined Memco from Allis-Chalmers Manufacturing Co where he was chief development engineer at the switchgear department. Most recently he has been on special assignment with the Matterhorn Project, Princeton University. He has also been with General Electric Co.

PERSONAL BRIEFS

Alabama Power Co's new assistant purchasing agent is **Guy B. Cofield.**

Coburn D. Hollister, general sales manager of Niagara Mohawk Power Corp, has been elected bureau chairman and chairman of the executive committee of Better Light Better Sight Bureau for a two-year term. He succeeds **W. G. McKie,** general sales manager of Rochester Gas & Electric Corp.

The purchasing and stores supervisor for Tacoma's Department of Public Utilities, **Shirley K. Brown,** has retired.

Paul C. Grove has retired as turbine operator of Potomac Edison Co's R. Paul Smith Plant in Williamsport, Md.

Citing new political responsibilities as Republican national committeeman from California, **Joseph Martin Jr** has resigned from the San Francisco Public Utilities Commission.

Edison Electric Institute has presented **Douglas H. Nelson,** Black Hills Power & Light Co lineman, with a medal for saving the life of a victim of electric shock.

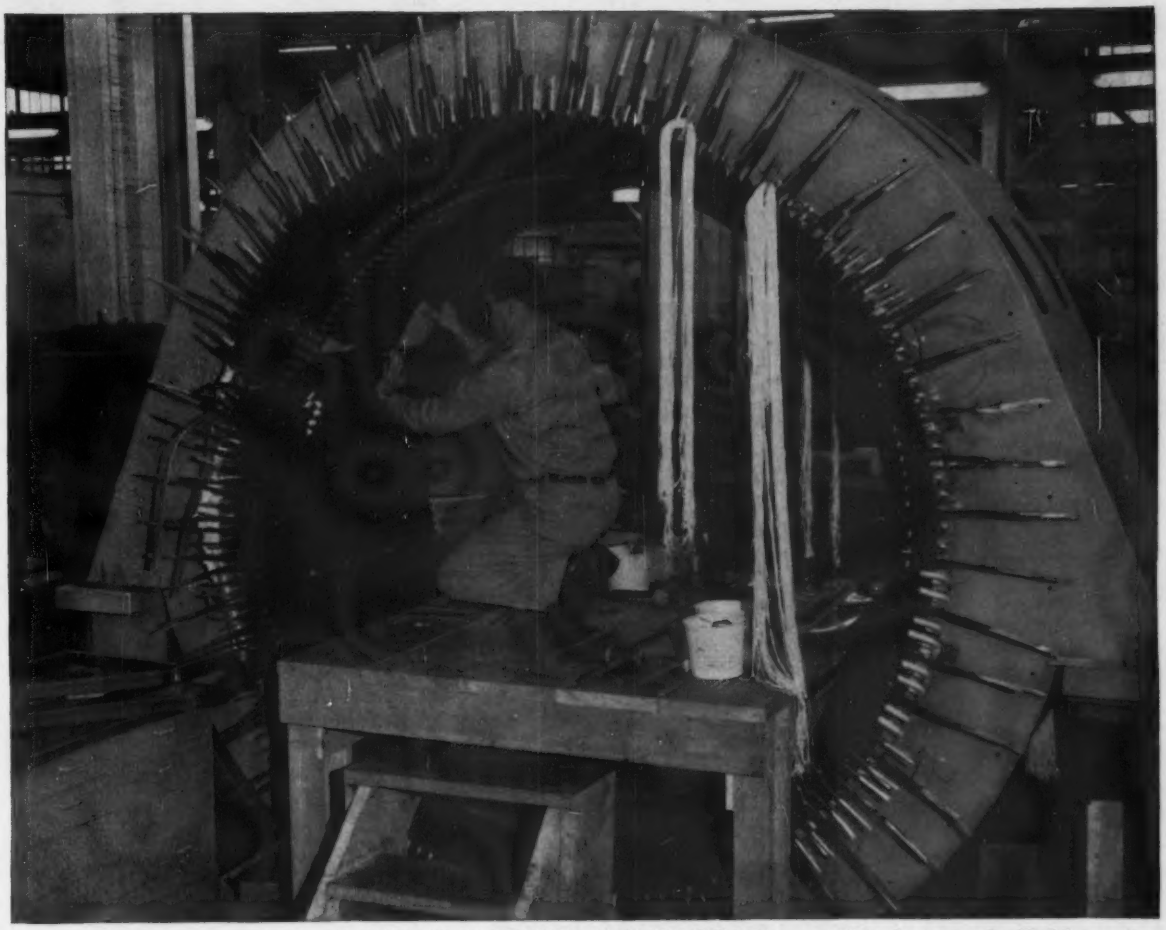
William E. Jones has been promoted to manager of the Travelers Rest branch of Duke Power Co. Other promotions at Duke Power: **Lloyd P. Julian** to superintendent of operation and **Cecil H. Lackey** to superintendent of divisions.

Peter W. Spell has been named manager of industrial sales for Northern States Power Co, with headquarters in Minneapolis.

Dayton Power & Light Co. has named **William J. McLain** chief electrical engineer, and **Garland Stamper,** senior electrical engineer, Engineering Division. **Richard H. Neal** has been made supervisor of transmission and distribution section; **Robert F. Muse,** assistant supervisor in charge of overhead distribution engineering; **Eldridge Whitlatch,** assistant supervisor in charge of transmission engineering in the same section; **Richard F. Wessell,** supervisor, power plant and substation section; **Kaiser M. Boyle,** supervisor, property accounting department; **James M. Nisonger,** head of the account classification section; **Richard M. Kramer,** supervisor of the depreciation section, and **Jeff A. Hayes,** assistant supervisor, continuing property records section.

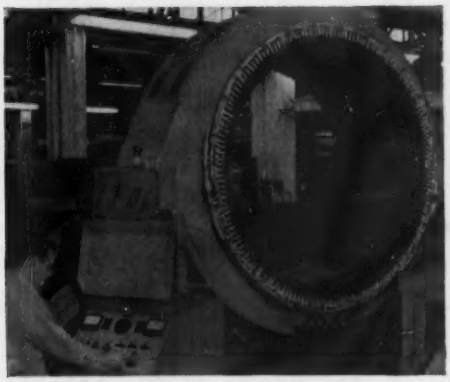
Virginia Electric & Power Co has named **Walker H. Newcomb,** manager, Altavista, Va.; **John K. Taylor,** executive assistant at Richmond; **William H. Blackwell Jr,** estimating supervisor, distribution department, Alexandria; **Eugene C. Keeling,** estimating supervisor, distribution department, Richmond; **Everett F. Eldred Jr,** superintendent lines, electric distribution department, Norfolk; and **Robert L. Jordan,** assistant operating supervisor at the Possum Point Station near Quantico.

Wilfred F. Ward has been chosen to succeed **E. D. Freeman,** retired,



Installing NECCOBOND coils in 4000 HP, 400 rpm, 6600-volt stator of mill drive motor.

NECCOBOND insulation system protects motors in severe environments



Completed winding passes 23,000-volt test.

Provides optimum resistance to moisture, heat, corrosive atmospheres

NECCOBOND is specified for rewinding many big rotating machines, like this 6600-volt steel mill motor, that have to perform in rugged environmental conditions.

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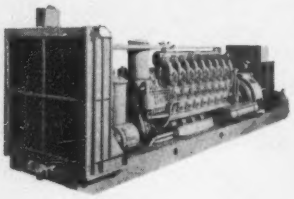

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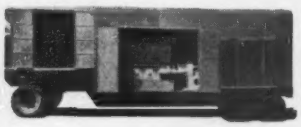

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CONSTRUCTING ELECTRICAL SYSTEMS
by J. F. McPartland and the Editors of
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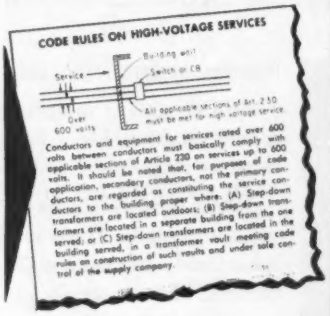
Here's a modern, comprehensive reference and instruction manual on the methods and techniques used in constructing systems for power, light, signals and communications. Covering the best practice on selecting, mounting, connecting and housing all types of electrical equipment, **this manual presents 1959 National Electrical Code data relating to installation. And a wealth of special illustrations are used throughout to clarify fine code points.**

Chapters are broken down on the basis of types of equipment to facilitate ready reference: lighting equipment — motors and controllers — conductors — raceways — switches — overcurrent protective devices — switchboards and panelboards — transformers — capacitors and regulators — power sources — high voltage — signals and communications.


CODE RULES ON HIGH-VOLTAGE SERVICES
Service
Switch or CB
Over 600 volts
All applicable sections of Art. 230 must be met for high voltage service.
Conductors and equipment for services rated over 600 volts between conductors must basically comply with applicable sections of Article 230 on services up to 600 volts. It should be noted that, for purposes of code application, secondary conductors, not the primary conductors, are regarded as constituting the service conductors to the building proper where: (A) Step-down transformers are located outdoors; (B) Step-down transformers are located in a separate building from the one served; or (C) Step-down transformers are located in the building served, in a transformer vault meeting code rules on construction of such vaults and under sole control of the supply company.

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as manager of Oklahoma Gas & Electric Co's El Reno district.

Duquesne Light Co has appointed **George A. Remalia** general superintendent, general stores department.

James Murphy has been named director of advertising and sales promotion at Allis-Chalmers Manufacturing Co. **A. E. Kilgour** has joined the power systems department. **William L. Ringland,** chief engineer, motor and generator department has received the company's first Scientific and Engineering Award for his invention of a new way of transposing conductors in large generators. **Dale T. Eyster,** has been named project manager, nuclear products, and **Richard K. Gregory,** assistant project manager. **Robert L. McMasters Jr** has been promoted to supervisor, distribution promotion, and **Donald E. King** to supervisory engineer, special control, engineering group. Newly appointed to the nuclear power department are **George L. Fox Jr,** assistant engineer, mechanical group and **Donald R. Roberts Jr,** nuclear power department's core engineering section. **R. C. Bown** has been made manager of sales, control department; **Marvin A. Bail,** assistant engineer, motor and generator department; **Donald Powichroski,** application engineer, switchgear department; and **Marquis B. Robinson,** engineering scientist in applied research, all in the Industries Group. Newly named to the steam turbine department are **Paul R. King, Edward W. Pianka,** and **John M. Vinson. Lawrence A. Navarro** has been named to the newly created position of manager of sales training; **C. E. Shaw** succeeds him as technical editor.

William J. Higgins has been named manager of systems and services, McGraw Edison Co.

Edward M. Gibbs has been made plant manager of Line Material Industries' plant at Birmingham, Ala.

Sylvania Lighting Products, division of Sylvania Electric Products, Inc, has made the following appointments: **Thomas H. Cashin,** marketing manager—large lamp

products; **Chalmer J. Carothers,** sales manager, industrial-commercial lamps; **Leslie E. Innis,** product manager-incandescent and fluorescent lamps; **Alan H. Foster,** division manager of marketing cost control; **Lawrence P. Pleasants,** sales manager, Cleveland district; **L. John Doyle,** field sales manager-large lamp products; **D. S. Gustin,** engineer-in-charge, Manchester, N.H. plant; **Albert W. Richards,** purchasing agent. **John E. Rhodes** has been named controller of Sylvania Electric Products Inc.

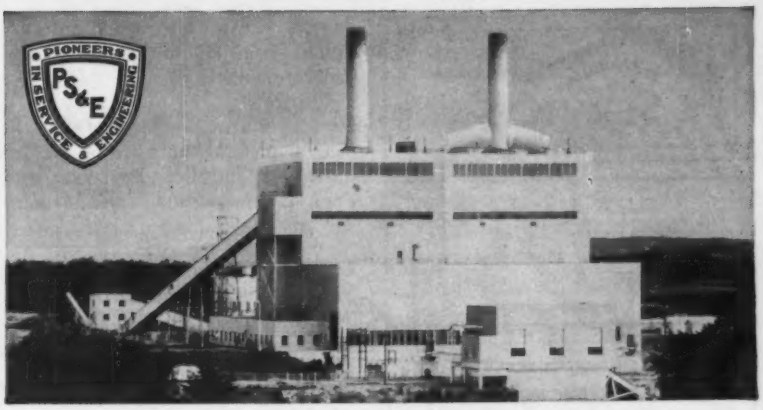
American Institute of Electrical Engineers will award medals to the following engineers at its Fall General Meeting in Chicago next week: **Dr Selden B. Crary,** system analysis engineer, Electric Utility Engineering Section, General Electric Co, the William M. Habirshaw Award for "contributions to the stability, reliability and economy of bulk power transmission systems, and international leadership in this field," **Dr Ernest Weber,** president, Polytechnic Institute of Brooklyn, the Medal in Electrical Engineering Education, for "excellence as a teacher in science and electrical engineering, for creative contributions in research and development, for broad professional and administrative leadership, and in all for a considerate approach to human relations;" and **Professor Perry Borden,** electrical engineering department, University of Dayton, the Morris E. Leeds Award, for "outstanding contributions to electrical measurements in the field of recording, control and telemetry; and helpful encouragement to younger colleagues."

Eugene S. Reed has been named sales manager of Rockbestos Wire & Cable Co, division of Cerro de Pasco Corp.

J. J. Orr has been named director of engineering, United States Rubber Co, succeeding **Carl A. Ostling** who retired.

Foster Wheeler Corp has elected **C. E. H. Verity** to the board of directors. He is managing director of the Corporation's subsidiary, Foster Wheeler Ltd.

Heavy Construction Division of Henry J. Kaiser Co has been re-



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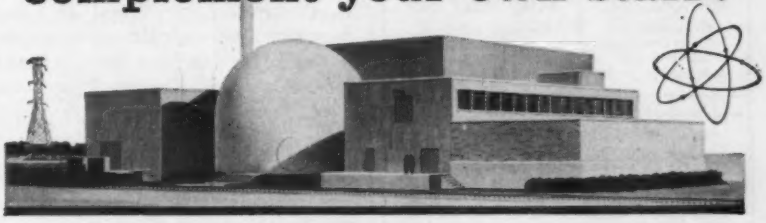

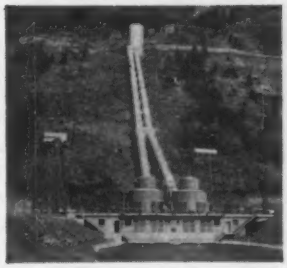

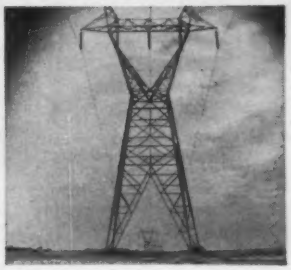

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Pioneer offers its services in all phases of Federal, State and local utility regulation, including natural gas and electric rate matters, certificate proceedings, licensed project accounting requirements, depreciation studies for rate case and income tax purposes, cost allocations and special studies.

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named Kaiser Engineers International. **John Hallett** has been made general manager.

Square D Co has made **James F. Magin,** general manager of the Industrial Controller Division, and **Paul A. Christenson,** division manager.

Federal Pacific Electric Co has named **C. H. Brittenham,** manufacturing manager of its Pacific Manufacturing Division.

Paul L. Black has been appointed sales engineer in Western Pennsylvania, West Virginia and several counties of Kentucky for the Wire and Cable Division of Copperweld Steel Co.

E. C. Dwelle has retired as sales representative and district manager of the Texas and New Mexico territory of James R. Kearney Corp.

OBITUARY

W. Heraly MacDonald, 56, manager of the Green Bay Division, Wisconsin Public Service Corp . . . **Robert E. Phenicie,** 51, personnel director, Wisconsin Public Service Corp . . . **Harry W. Goodman,** 69, vice president and director of sales, Circle Wire and Cable Corp . . . **Stephen J. Lent,** 82, former head of the statistical department, Boston Edison Co . . . **Guy C. Myers,** 71, public power agency broker in Seattle, Wash., . . . **Gerald T. Clifford,** 57, assistant to the vice president in charge of sales, Metropolitan Edison Co . . . **J. Hubert McIsaac,** Detroit Edison Co assistant controller . . . **James F. Fogarty,** 72, retired head of the former North American Co, public utility holding company . . . **Dr. Harry K. Ihrig,** 62, vice president in charge of research for Allis-Chalmers Manufacturing Co . . . **Ralph D. Cutler,** 75, retired vice president, Hartford Electric Light Co.

Thaddeus Scott Barlow, 80, retired superintendent of the Consolidated Edison Co of New York, Inc . . . **Jesse A. Crary,** 75, retired sales manager of General Electric Co's Peoria, Ill., office . . . **Amory R. Haynes,** 72, retired Tacoma, Wash., electrical engineer.

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3—1000 kva Westinghouse, 1/13800/480
3—1000 kva Westinghouse, 1/13800/2400/4160Y
3—1000 kva Standard, 1/44000/6900
3—1000 kva Standard, 1/69000/4160Y/2400
3—1000 kva Standard, 1/34400/480
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DEPARTMENT OF THE INTERIOR, Bureau of Reclamation. Sealed bids (Invitation No. DS-5404) will be received at Denver, Colorado, until 2 p.m., Mountain Standard Time, November 10, 1960, for furnishing, installing and testing two (2) 74,444-kva, 13,800-volt, 225-rpm, vertical-shaft, 60-cycle, alternating-current generators for Clear Creek Powerplant, Central Valley Project, California. Shipment is required within 510 days. For particulars, address Bureau of Reclamation, Building 53, Denver Federal Center, Denver, Colorado. Floyd E. Dominy, Commissioner.

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Penstocks drop 1,000 ft to powerhouse as . . .

B.C. Electric Ends 264-Mw Job

A 14-year construction program on British Columbia's Bridge River reached completion last month when B.C. Electric Co's 264-Mw Bridge No. 2 project was officially placed in service. Completion of the plant brings the total developed power potential in the Bridge River area to 510 Mw, making the $185-million project the company's largest single source of hydro power.

Included in the project are two massive earth-fill dams, two two-mile tunnels through a mountain, and four power plants. Leaving the lake created by the second dam, waters are carried through the tunnel, then plunge 1,000 ft down through twin mile-long, 9-ft penstocks (left) to the Bridge No. 2 powerhouse. A similar system serves Bridge No. 1.

Power is carried to the Vancouver area by 230-kv and 345-kv lines. Of the two dams, Mission storage dam is 1,000 ft thick at its base and stretches 1,200 ft across the river valley. The 180-ft high dam has created a 750,000-acre-ft reservoir. The earlier storage dam, LaJoie, is 287 ft high and reported equal in bulk to Egypt's great pyramid.

Work on the Bridge River area began in 1927, when the first diversion tunnel was built, but ground to a halt in the depression. It was resumed in 1946.

Interior Okays 350-Mw Four Corners Plant

Plans for a 350-Mw Four Corners Power Plant on the Navajo Indian Reservation have been approved by the Interior Department.

Cost of the Arizona Public Service Co plant near Fruitland, N. M., will be about $62 million. Transmission line construction should bring total to over $100 million.

Construction is expected to start soon, with initial plans calling for two 175-Mw units. Arizona PS plans ultimately to expand the plant's capacity to 1,000 Mw.

Interior Department Secretary Fred Seaton announced approval of the agreement between Arizona PS, the Navajo Tribal Council, and Utah Construction & Mining Co while attending the Navajo Tribal Fair at Window Rock. Formal agreements will be signed as soon as minor legal technicalities have been worked out.

The agreement involves site leases for the plant, approval of a wholesale power contract with the tribe, and authorization for Utah C&M to mine and deliver coal to fuel the plant (EW, Aug. 1, p 27).

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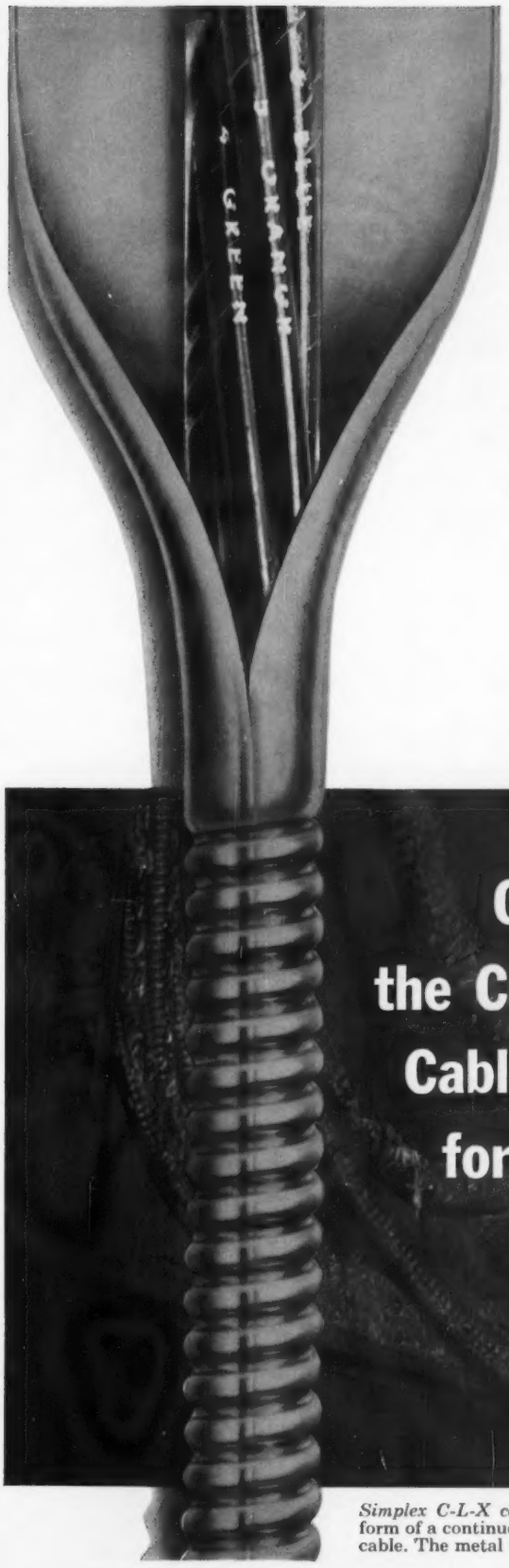

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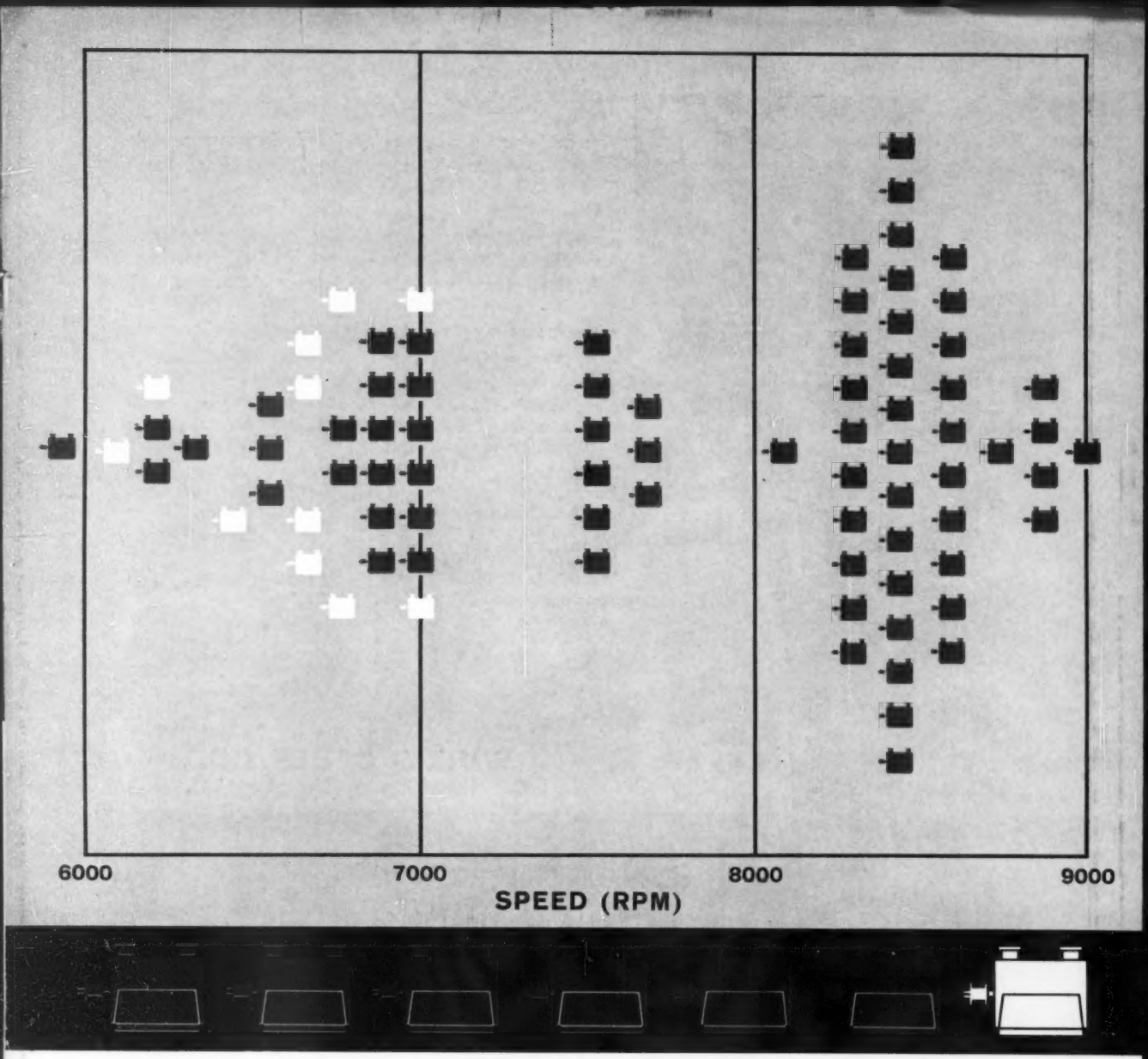

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In a booklet just printed Worthington discusses "The ten most important features in boiler feed pumps today." From it you'll quickly understand why boiler feed pumps are now freed from the traditional 3600-rpm limitation. And you'll read basic design considerations that will help you in boiler feed pump selection. Write Worthington Corporation, Dept. 45-16, Harrison, New Jersey.

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